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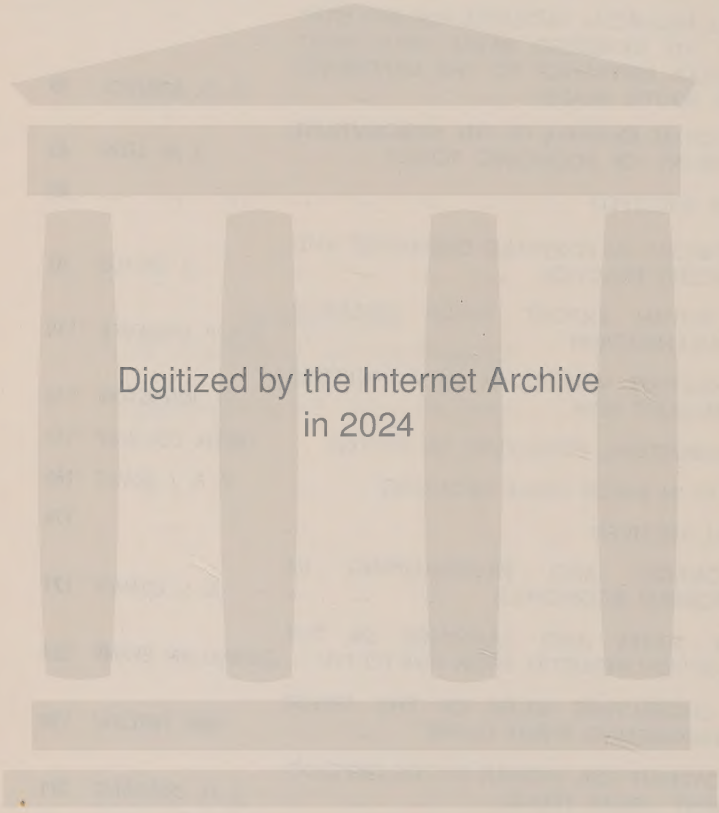

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A Reconsideration of Hobson's Theory of Unemployment[1]

The purpose of this essay is to argue for a reconsideration of Hobson's theory of unemployment. It may be objected that such a task is unnecessary : has not Hobson's place in the history of economic thought been ensured by the praise which he received from the author of the *General Theory of Employment, Interest and Money* ? The answer to this is that Keynes, though generous in his praise, was ungenerous in the account he gave of Hobson's theory, largely because he contrasted Hobson's analysis of the origin of depression with his own theory of a state of under-full employment equilibrium. Since Hobson's theory comprehended the latter situation Keynes' criticism of Hobson may reasonably be challenged, *viz.*, that the "root of his mistake" lay in "his supposing that it is a case of excessive saving causing the *actual* accumulation of capital in excess of what is required, which is, in fact, a secondary evil which only occurs through mistakes of foresight ; whereas the primary evil is a propensity to save in conditions of full employment more than the equivalent of the capital which is required, thus preventing full employment except when there is a mistake of foresight." [2]

[1] John Atkinson Hobson, 1858-1940. The following works will be referred to in this paper, using the indicated abbreviations in footnote references.

The Physiology of Industry (with A. F. Mummery), John Murray, London, 1889. (*Industry*).

The Evolution of Modern Capitalism (2nd Edn.), Walter Scott, London, 1901. (*Capitalism*).

The Industrial System (2nd Edn.), Longmans Green, London, 1910. (*I. S.*).

An Economic Interpretation of Investment, The Financial Review of Reviews, London, 1911. (*Investment*).

The Economics of Unemployment, George Allen and Unwin, London, 1922. (*Unemployment*).

Rationalisation and Unemployment, George Allen and Unwin, London, 1930. (*R. U.*).

"Underconsumption, An Exposition and a Reply," *Economica*, 1933, pp. 402-417, 425-427. (*E.*).

[2] *General Theory*, p. 367.

Later writers have not clarified the picture and are even contradictory. Professor Hansen, whilst admitting that Hobson does "make clearer than his predecessors the role of growth—changes in technique and increase in population—in opening investment outlets," argues that "with respect to consumption, his treatment . . . suffers . . . by not having the concept of a *schedule* relating consumption to income." [1] On the other hand Dr. Klein has stated: "while Hobson analyzed, in some detail and very brilliantly, the saving process, he failed to give a good account of investment and its determinants . . . We find that Hobson had a clear picture of what determines the savings schedule." [2]

When eminent authorities disagree there is, perhaps, some justification for a re-examination of Hobson's work. A reasonably comprehensive account of his theory does not exist, as far as I can discover, though several writers have shown an awareness of the real nature of his contribution.[3]

I.

Hobson's analysis follows a pattern set by a stream of writers which includes such names as Sismondi, Malthus, Rodbertus and Marx. He was concerned with the analysis of a progressive economy in which the effects of capital growth resulting from saving were explicitly taken into account. He argued that the proportion of national income which people will want to save and invest is not necessarily the proportion of income which can profitably be invested. The analysis of the disharmony between these two aspects of the saving process explains the necessity of a self-generating cycle combined with secular growth in a modern industrial economy. The unemployment theory of Keynes features implicitly in this

[1] A. H. Hansen, *Business Cycles and National Income*, New York, 1951, p. 255.

[2] L. R. Klein, *The Keynesian Revolution*, New York, 1947, p. 137.

[3] *e.g.*, W. Mitchell, *Business Cycles*, New York, 1927; E. F. M. Durbin, *Purchasing Power and Trade Depression*, London, 1933; O. Lange, "The Rate of Interest and the Optimum Propensity to Consume," *Economica*, 1938; E. D. Domar, "Expansion and Employment," *American Economic Review*, 1947; J. Robinson, "Mr. Harrod's Dynamics," *Economic Journal*, 1949.

system in the form of a discussion of the forces which bring the contraction phase of the cycle to an end.

It is necessary, at the outset, to draw attention to a matter of definition which has probably contributed to the misunderstanding of Hobson's theory. He was obsessed with a normative definition of "saving" and really wished to reserve the use of this word for those dispositions of money income which result in net capital formation. Thus :

> "Spending means buying commodities with income; saving means buying productive goods or instruments with income." [1]

> "The *real economic function* of saving must be clearly kept in mind. It does not consist in not spending . . . It consists in paying producers to make more non-consumable goods for use as capital . . . " [2]

Hobson, therefore, often used the word "saving" in the sense of "net investment," *e.g.*,

> "The real income of a community in any given year is divisible into two parts, that which is produced and consumed, that which is produced and not consumed—*i.e.*, is saved." [3]

But he was well aware that all acts which the individual regards as "saving" do not necessarily result in capital formation. He did not deny that individuals might hoard or hold bank deposits, though he thought hoarding abnormal,[4] or buy existing securities. His attitude was that such acts do not constitute "social saving" or "efficacious saving" but he neglected the precaution of using a separate term to define them. He realised the importance of individual non-social saving.

> "From the stand-point of the individual who saves, his action consists in a refusal to demand commodities, a not-spending, or, more strictly, a postponement of

[1] *I. S.*, p. 50.

[2] *Unemployment*, p. 34, my italics.

[3] *Capitalism*, p. 207, also *cf. I. S.*, p. 55.

[4] *I. S.*, p. 50.

> spending. In primitive industrial societies, or *in disturbed conditions of more advanced societies, much refusal to spend takes the form of hoarding money . . . An increase of hoarding inevitably tends to depress trade . . .* "[1]

The view that hoarding is abnormal except in disturbed conditions is quite reasonable. Hobson usually made it clear from the context of his argument whether he meant social or private saving, but he needs a careful reader.

Hobson had a clear concept of a personal schedule relating saving to income.

> "Though we fear inductive evidence upon such a point is not available, it will hardly be disputed that the proportion of saving is generally in direct ratio to the sizes of incomes, the richest saving the largest percentage of their income, the poorest the smallest." [2]

> "Generally speaking, the highest rate of saving will be found in those classes of business men who, after attaining a fairly high level of comfort, find their incomes still rising rapidly." [3]

He argued unconvincingly that the larger savings-income ratio of the rich arose because their incomes consisted extensively of "unproductive surplus," *i.e.*, of factor rents based on natural or contrived scarcity. He felt that consumption was related in some mysterious "natural" way to the effort involved in earning an income.[4] For this reason he often referred to the savings of the rich as being "automatic." Methodologically, Hobson's hypothesis of the personal savings schedule did not need the support of his dubious *a priori* "proof" but his focus on the entrepreneur as being the main source of monopolistic power and of savings was important because it partly explains his aggregate schedule.

[1] *I. S.*, p. 50, my italics.

[2] *I S.*, p. 295. See also *Unemployment*, p. 36, for a revealing tabular "schedule."

[3] *Investment*, p. 36.

[4] See his *The Problem of the Unemployed*, London, 1896 ; *I. S.*, Chapters 4–6 and p. 294. In *Unemployment*, p. 45, he has cogent reasons to explain the relatively lower savings of the poorer classes.

For a theory of unemployment it is, of course, necessary to work in terms of a hypothesis concerning the co-variation of aggregate savings and aggregate income. Such a concept forms a basic part of Hobson's theory.

> " . . . if there exists a normal tendency to try to save and apply to capital purposes an excessive proportion of the general income, we have a valid explanation of the actual phenomena of fluctuations and depressions." [1]

He assumed that the proportion of the national income which is saved varies according to the phase of the cycle, being relatively high in prosperity and low in depression. Two factors accounted for the variation. First, "a conservatism in the arts of consumption" which causes changes in consumption to lag behind changes in income in both directions. Second, changes in the level of income over the cycle are associated with shifts in the distribution of income, profits rising relative to wages in prosperity and declining in depression. The following quotations illustrate his argument.

> "The standards of life are for most people more conventional and more stable than the standards of work. The result is that where the command of the new wealth due to industrial progress passes largely into the hands of a small class, much of it is accumulated and reapplied to industry from sheer inability to make consumption keep pace with rising income." [2]

> "Though more employment will give higher aggregate wages, wage-rates will not rise so fast as prices and profits . . . It signifies for us the important fact that during rising prices and reviving trade the distribution of the product, *i.e.*, of real incomes, is favourable to the employing and capitalist classes, unfavourable to labour . . . since saving . . . comes mainly from the accumulation of surplus income of the capitalist and employing classes, the under-saving which accompanied depression now

[1] *Unemployment*, p. 147, see also, p. 124.
[2] *I. S.*, p. 295.

> gives place to what will once more become over-saving when the revival of trade has gone some distance . . . "[1]

> "In every period of depression saving is diminished more than spending. This applies not only to the wage earners whose total contribution to the general fund of saving is never very large, but to the propertied and employing classes, whose large automatic savings are to a large extent virtually cancelled by a trade depression."[2]

The most interesting example of the aggregate schedule occurs in the *Industrial System* and demonstrates Hobson's early understanding of the nature of the under-full employment equilibrium. Hobson is here discussing the effects of an increase in the desire to save in a hypothetical economy previously experiencing full employment. He points out that the attempt to raise the rate and proportion of saving involves a double diminution of effective demand. Less is spent on consumption and this reduces the derived demand for investment.[3] "Since there is a reduced demand both for commodities and for new capital goods, there will be a shrinkage of money income and real income among all industrial classes."[4] What happens to the increased savings which, by definition, cannot flow into new investment? Some, he says, will be hoarded, the remainder will find an outlet in the purchase of existing properties which are sold by those who want to maintain their consumption in spite of declining incomes.[5] Such saving is only a transfer of spending but there remains a net deflationary effect because

> "the class which gets [the money] only maintains its former spending, while the class which parts with it has reduced its total spending. So there remains as a net

[1] *Unemployment*, p. 68. Hobson uses the terms "under-saving" and "over-saving" in the sense of rates and proportions of income relative to the "normal" rate and proportion which would allow full employment. *cf. Unemployment*, p. 135; *R. U.*, p. 45; *I. S.*, p. 303.

[2] *Unemployment*. p. 56.

[3] His justification for this will be considered presently.

[4] *I. S.*, p. 302.

[5] This argument dates from his earliest work but Hobson may have been influenced by Johannsen's brilliant study, *A Neglected Point in Connection with Crises* (New York, 1908), which he acknowledged.

> effect . . . a reduction of total demand for commodities and new forms of capital . . . reduced employment for capital and labour . . . and shrinkage of the general real income. This is the condition known as depression." [1]

Now he asks the crucial question: "Why does it not continue indefinitely and grow ever worse?"

> "Because," he says, "from the very beginning of the maladjustment between spending and saving a process of readjustment gradually comes into play. Directly a shrinkage in demand for commodities and new productive capital occurs, the lessened rate of production begins to reduce all incomes, including those of the saving class. Aggregate income no longer stands at twenty, but falls to eighteen, or even seventeen. The saving class who were trying to save four out of a total twenty, leaving sixteen for spending, are not willing to save four or even three out of an aggregate income reduced to eighteen or seventeen. Their permanent standard of comfort stands in the way. When the shrinkage of production and of income has gone far enough, not merely is the actual amount of saving reduced, but the *proportion* of saving to spending is brought back towards the normal rate which preceded the attempt to oversave, or even below that rate. When the depression has reached its lowest, there is for a time a state of actual under-saving, *i.e.*, an insufficient provision of new productive capital to meet the reasonable calculations of future demand for commodities." [2]

Although his argument lacks rigour it will be admitted that Hobson gets at the heart of the problem of equilibrium, *viz.*, that the deflationary excess savings are eliminated by the contraction in the level of income which they induce.[3]

II.

The next step is to consider Hobson's analysis of the factors which determine the amount of investment which can

[1] *I. S.*, p. 303.
[2] *ibid.*
[3] *cf.* also, *Unemployment*, p. 55.

profitably be undertaken. From its inception his theory has rested firmly on the basis of a definite capital-consumption ratio,[1] given at a point of time but always being modified by technological development. This concept is justified in his early books by analysis of the nature of the industrial system. The "mutually inter-dependent" nature of the quantities of capital and labour in the main and tributary streams of industrial processes led him to conclude that, under conditions of economic working,

> "pooling together all the productive processes, there must be a definite quantitative relation between the rate of production and the rate of consumption . . . between the quantity of employment of capital and labour and the quantity of commodities withdrawn from the productive stream within any given time." [2]

The capital-consumption ratio sets a limit to the amount of "socially useful" saving which can be done in a progressive economy.

> "A large proportion of the modern social income can be saved because it is possible to put it into costly forms of capital, the services of which will fructify . . . a long time hence . . . railroads . . . new harbours . . . afforestation . . . " etc.[3]

But, he argued, this did not mean that there were no limits to the possibilities—definite limits were set by two factors. "In the first place, most forms of new capital, even in this age of elaborated indirect production by machinery, very soon result in promoting an increased flow of finished goods," so new investment is constrained by future demand for its output if it is to be socially useful. Secondly, investment for the distant future is "restricted principally by our inability to forecast far ahead either the needs of coming men or the most economical modes of providing for them." [4]

[1] It was really a capital-output ratio since he realised that an increase in consumption involved both an increase in machines to make goods and an increase in machines to make machines. See *Capitalism*, p. 195, fn. 1 ; *I. S.*, p. 39.

[2] *I. S.*, p. 41.

[3] *ibid.*, p. 52.

[4] *ibid.*, p. 52.

He concludes :

> "A little reflection will make it evident that this implies the maintenance of a definite proportion between the aggregate of saving and of spending over a term of years . . . If this proportion is exceeded one year it must be curtailed the next . . . Though the proportion . . . is always slowly changing, at any given time it must rightly be regarded as fixed in the sense that there is an exact proportion of the current income which, in accordance with existing arts of production and existing foresight, is required to set up new capital so as to make provision for the maximum consumption throughout the near future. Any miscalculation or other play of social forces which disturbs this proportion, inducing either too much saving or too much spending, causes a waste of productive power and a restriction in aggregate consumption." [1]

Perhaps it needs rather more than "a little reflection" to convert a relationship between capital and consumption into one between a rate of increase of capital and a rate of consumption, but Hobson was quite correct in supposing that the conversion could be made. What he meant was that for steady growth the two sides of the saving process must be compatible. The community will try to save and invest a proportion s of the real national income Y. This must not produce a more rapid rate of capital accumulation than is allowed by the technologically determined capital-consumption ratio. If real capital is denoted by K and real consumption by C, Hobson postulated a ratio of the following type : $K = \beta\,(1 + e)\,C$, where $e.\,C$ is the value of distant future consumption. From this ratio the permissible maximum amount of "socially useful" investment in a period may be derived, *viz.*, $I = \beta\,(1+e)\,\triangle\,C$. For steady growth this quantity must equal the desired rate of real saving from a full employment income, *viz.*, Real Savings $(S) = s.\,Y = \beta\,(1+e)\,\triangle\,C$.

[1] *ibid.*, pp. 53–4.

Since Hobson used the basic identity $Y \equiv C+S$ the equilibrium condition for steady full employment growth is given as :

$$\frac{\Delta Y}{Y} = \frac{s}{1-s} \cdot \frac{1}{\beta\,(1+e)} \quad ,$$

where $\frac{\Delta Y}{Y}$ is the maximum possible rate of growth in real income, given the growth of population and changes in technology. This equation may be regarded as specifying the value of s, the maximum possible proportion of income which can be saved and invested. If s exceeds the permitted value capital would be created at a rate later proved to be excessive ; according to Hobson it would provoke crisis and depression. A value of s below the determined figure implies a rate of growth of capital and consumption below the possible maximum.

Several suppressed assumptions must be made explicit. The simple argument assumes that the quantity of money and the income velocity are constant. Constant money rates of Y, C and I then become increasing real rates as a rate of price fall occurs which is the reciprocal of the rate of real growth due to expansion and innovation. This involves objections, *viz.*, that money wage rates must adjust to allow expansion and that the real value of depreciation funds, bank credit etc. increase and, in effect, raise the rate of desired saving and investment. To meet these objections the quantity of money may be increased to give a constant price level—but now, as Domar has shown,[1] the money rate of investment must grow or the economy cannot. Therefore, in either case, the proportion s in the preceding discussion must be interpreted in a wider sense than the savings of private individuals, it must cover all the savings of the community including new creations of money which finance part of the new investment. This new money is a type of forced saving.[2]

[1]E. D. Domar, *op. cit.*

[2]Hobson showed that he was aware of these considerations in the later versions of his theory. *cf. E.*, pp. 402–5.

All this is now familiar as a result of the work of Harrod and Domar.[1] The relation between Hobson's analysis and that of Harrod may be indicated. Harrod takes the savings-income ratio as given and with the marginal capital-output ratio deduces a "warranted rate of growth" which he compares with the "natural rate of growth" of income needed to maintain continuous full employment. Hobson took the latter rate of growth as a datum and, using a capital-consumption ratio, deduced a "warranted" or "justified" rate of saving. Hobson's "correct proportion" of savings is therefore the proportion which equates the natural and warranted rates of growth of income. In each case there is an allowance for long-range investment which may temporarily absorb savings without giving rise to immediate additions to total output. Hobson's reference to the "waste of productive power" resulting from too much spending (*i.e.*, *s* less than the "correct proportion") amounts to the specification of a warranted rate of growth which is less than the possible natural rate. Hobson's intuition seems to have led him towards the concepts of dynamic equilibrium which Harrod and Domar have developed and analysed. The following statement may be presented to show Hobson's understanding of the implications of the basic growth equation.

> "An increased rate of saving on the part of a community must either take shape in the continuous increase of new forms of capital *produced in expectation of an increase in the rate of growth of future consumption,* or in a compulsory substitution of present for past saving, effected by enabling present over-savers to get possession of properties already in existence which represent past savings. In the latter case, since the acts of saving stimulate no new production of capital forms, they involve a corresponding volume of unemployment." [2]

[1]Harrod, "An Essay in Dynamic Theory," *Economic Journal,* 1939 and *Towards a Dynamic Economics,* London, 1948. Domar, *op. cit.* and "Capital Expansion, Rate of Growth, and Employment," *Econometrica,* 1946.

[2]*I. S.*, p. 305, my italics.

The essence of Hobson's theory was that, whilst for a time the community might save the "correct proportion" of its general income, there would be an inevitable tendency for this proportion to be exceeded. The result would be the development of crisis and depression. But he did not argue that the economy experienced continual over-saving and over-investment. After the crisis the industrial system would experience a period of stagnation, of under-saving and under-investment, lasting until the forces of obsolescence and population growth had once again restored the profitability of large-scale real saving and investment. Some of the details of this cyclical process must now be considered.

III.

It is convenient to begin with the period of prosperity, when, for a time, "the right adjustment between real capital and rate of consumption" has been restored and "a spell of good trade with full employment for capital and labour ensues." [1] The high level of activity is, in part, the result of the expansionary operations of the banking system which becomes infected with the rising confidence of the traders and producers.

Hobson's views on the part played by the forces of psychology and the banking system are interesting. He emphasised the fact that he had no time for theories which explained booms and depressions as "tidal movements in the minds" of business men and bankers.[2] At the same time he realised that the whole "psychological-financial play of credit" was an important feature in the trade cycle. He believed that it could be explained as a secondary and dependent process, grounded on objective factors such as changes in prices and orders which themselves were to be explained by the more fundamental forces of over- and under-saving. Thus he argued :

> "These increased credits express and measure the belief of bankers in the renewal of industrial activity. But

[1] *I. S.*, p. 306.
[2] See *I. S.*, p. 301 ; *Unemployment*, pp. 28, 59.

> their belief is based upon the actual evidence of reviving trade furnished to them by their customers, and it is on the strength of this that they extend banking facilities."[1]

For reasons already considered, the period of good trade cannot last indefinitely. The rising level of incomes, the conservatism of consumption reinforced by the changed distribution of incomes cause the rate of saving to rise until it exceeds the "correct proportion." At this stage over-saving means literally over-investment so there is no question of immediate deflation.

> "The immediate effect upon demand for labour of demanding capital goods (the application of savings) is the same as that of demanding consumptive goods." [2]
>
> "So long as over-saving is translated without delay into over-investment, *i.e.*, the creation of capital goods at a pace proved later on to be excessive, the seeds of the depression thus sown in the economic body are not visible." [3]

The way in which the seeds are sown is important.

In the first place the over-saving would result, he thought, in an excessive multiplication of existing forms of capital. This becomes possible because there is no harmony between the social interest and the self-interest of individuals.

> "It may pay individuals to build new factories and put in new machinery where it would not pay the community to do so, were it the sole owner of the means of production. The knowledge that enough capital is already invested in an industry to fully supply all current demands at profitable prices has no power to deter the investment of fresh capital, provided the new investors have reason to believe their capital can be made to displace some existing capital owned by others." [4]

[1] *Unemployment*, p. 62.

[2] *I. S.*, p. 305.

[3] *E.*, p. 426. Dr. Klein's view (*op. cit.*, p. 137) that: "A high rate of savings which are actually offset by investments provides a net stimulus to the economic system, but Hobson implied that such offsets in both depression and prosperity cause under-consumption and deflation" seems to be contradicted by these quotations.

[4] *Capitalism*, p. 202.

> "It is to the interest of [the company promoter, the builder architect, machine producer, etc.] to bring into the field of production new forms of capital, quite independently of the question whether the condition of a trade or the consumption of the community have any need for them."[1]
>
> Secondly :
>
> "An important contributary cause of some modern depressions has been the excessive application of capital and business enterprise to certain fields of fundamental industry. Railway construction with its appendages of docks, harbours, warehouses, etc., has been a notorious example." [2]

He quotes Burton, *Financial Crises*, on the link between railway construction and the cycle in the United States from 1848 to 1890, and goes on to say :

> "The statistics of Great Britain's foreign investments bear out this ascription of over-investment in fundamental industries of a speculative order as a precipitating cause of depressions." [3]

While they last such ventures cause full employment in the basic trades of coal, engineering, etc., but, when it becomes evident that they have been taken too far, a financial crisis and an "era of bankruptcy and reconstruction sets in."[4]

It must be noted that, unless the whole blame is to be placed on the company promoter and his colleagues, the root cause of over-investment in Hobson's system must be regarded as the imperfect foresight and unwarranted optimism of those who employ their own or borrowed money in new investment. The time-lag between the act of investment and the flow of consumer goods, which he recognised, makes this quite a plausible theory, though it suggests that psychological factors are rather more than a secondary causal factor as he maintained.

He argued, then, that the unco-ordinated individual decisions of businessmen would lead under conditions of boom

[1] *Capitalism*, p. 203.
[2] *Unemployment*, p. 75.
[3] *ibid.*
[4] *ibid.*

psychology to excessive capital formation and a resulting generalised over-supply of consumer goods. As a result :

> "When trade activity has reached a certain height, the difficulty of finding a remunerative market for all the product at current or even lower prices becomes apparent . . . Markets are visibly over-stocked and the capacity exists to go on over-stocking them." The "keen classes of businessmen"—the merchants and bankers—conclude that the upward movement has run its course ; "the merchant draws in his orders and the banker his credits."[1]

The changed mood of the merchants and bankers is again founded on objective factors—weakening prices and visible over-stocking. But the bankers may close down with a promptitude that brings financial and commercial crisis. Cautiously applied, the credit contraction causes "a longer, slower process of price-fall and depression, leaving large quantities of frozen credits to be liquidated by a gradual marketing of the frozen goods which are the economic counterparts." [2]

The system is now experiencing over-saving and over-production. Attention must be drawn to the precise meaning of these concepts, since Hobson used them in two senses, a fact which probably helped to obscure his argument.

The crisis is precipitated by over-saving in the sense of over-investment, *i.e.*, by a *process* of over-saving. But the creation of new capital forms does not continue on this excessive scale.

> "It must, however, be remembered that this over-saving is not measured by the quantity of new mills, machinery, etc., put into industry. When the mechanism of industry is once thoroughly congested, over-saving may still continue, but will be represented by a progressive under-use of existing forms of capital, that unemployment of forms of capital and labour which makes trade depression." [3]

[1] *Unemployment*, p. 63. Also, *I. S.*, p. 299, 301.

[2] *Unemployment*, p. 63.

[3] *Capitalism*, p. 207, also pp. 176–9.

Overproduction may also exist as a *state* of excessive stocks in conditions which might be described as a *process* of under-production.[1]

These careful definitions were not repeated in later works with the result that references to over-saving and over-production in the sense of *states* can be misconstrued as referring to *processes*. But Hobson's meaning was usually quite clear from the context of his discussion and he frequently referred to depression as being a condition of *under*-saving. It is hard to understand how Keynes could have overlooked such statements as the following :

> "I wish to make it quite clear that my general charge of over-saving as the root-cause of fluctuations and depressions is quite consistent with the admission that during a deep depression there is under-saving in the sense of a rate and proportion of saving to spending inadequate to the normal needs of a progressive industry."[2]

To revert to the main argument : the crisis with its weakening of prices and contraction of credit causes a drastic change of business confidence. Merchants cancel their orders and entrepreneurs realise the futility of constructing new capital under such conditions. Credit is required "not in order to earn profits but to prevent collapse." New savings instead of going into the capital market are held on deposit in banks. The result is general contraction.

> "In this situation industrial investment slows down. Money available for investment waits in bank reserves, or is utilised for short loans. This admitted "lag" of investment checks further the processes of production, especially in the basic industries, creating more unemployment and wage reductions, which again react in shrinking demand for final commodities." [3]

[1] *Capitalism*, pp. 168–9.

[2] *Unemployment*, p. 135. *cf.* also *I. S.*, p. 303 quoted earlier, and *R. U.*, p. 60, for an illuminating comment on the current depression along the same lines.

[3] *R. U.*, pp. 132–3. *cf.* also *I. S.*, pp. 300–306 ; *Investment*, pp. 86–8.

Hobson realised that he had to meet the objection that the "glut" of consumer goods which resulted from the over-investment would be absorbed by extension of demand induced by price reductions. He argued that this would not happen.[1] In the first place,

> "the discovery that an excessive power of production at the former price level exists may not lead to a cutting of prices . . . It may lead . . . to a combination of producers to restrict output and hold up the prices. This, of course, involves the refusal to utilise the full available productive power of capital and labour." [2]

Secondly, he saw clearly that general price reductions were ineffective equilibrators because they involve a more than equivalent fall in aggregate money incomes. The initial price reductions would lead to some increase in consumption but not enough to prevent the emergence of a "glut" of consumer goods and, as a consequence, considerably diminished production and employment, usually with wage decreases for those who remained employed. The reduction in activity quickly reverses the initially favourable effect of the falling prices. The real check to contraction, he argued, is provided by the conservatism of consumption, which, in conjunction with the generally declining real and money incomes causes the almost complete disappearance of savings.[3]

The duration of the depression Hobson linked to the time needed to absorb the excessive stocks of fixed and working capital, the former being absorbed by obsolescence, under-maintenance and population growth,[4] the latter by the

[1] Price reductions which follow from reduced costs are not concerned here. These he argued would cause no trouble provided the savings-income ratio was maintained at the "correct" figure. *cf. R. U.*, pp. 48–9, 128–9 ; *E.*, p. 403.

[2] *Unemployment*, p. 54. He admitted that this objection might have been invalid in an age of small competitive businesses.

[3] *Unemployment*, pp. 50–55, also *Industry*, Chap. 4. His theory led him to advocate resistance by workers to wage cuts since this would, by improving their position relative to profits, reduce the savings ratio and make for fuller employment. Like Keynes, he saw the further advantage of wage-rigidity in reducing the severity of price fluctuations. *Unemployment*, pp. 90–1.

[4] *I. S.*, p. 306 ; *R. U.*, p. 134 ; E., p. 417.

reduction of current production of consumer goods below the level of current demand.[1]

His theory of recovery resembles that of Hawtrey in focussing attention on the merchants and traders, but their behaviour is not linked to the unplausible feature of interest rates, it depends essentially on market conditions and forecasts. He argued that eventually the excessive stocks of consumer goods would become depleted and that it would become obvious to businessmen that current production would be insufficient to meet future expected demand. The wholesalers are usually the most sensitive and the first to take action. "In anticipation of a growing volume of sales at higher prices they make contracts with manufacturers and other producers for future delivery of materials and goods." [2] These producing firms need to replenish their working capital so they apply to the banks for credit. The banks are prepared to expand the supply of credit because they regard the new contracts of the merchants as proof of reviving trade.[3] The effect of the new money and the demand for raw materials causes an initial rise in prices which assists the generation of optimism, since Hobson's businessman pays great attention to current trends and prices. Also in conjunction with the wage-lag it implies rising profits. With rising prices, profits, output and consumption we are climbing back into the period of prosperity and the cycle is repeated.[4]

Hobson was criticised by Keynes [5] for neglecting the part played by the rate of interest. Formally his argument would have been improved by the inclusion of a theory of interest but the omission in no way affects the essentials of his argument.

There was no real difference between Hobson and Keynes regarding the upper turning point. Keynes admitted that the predominant cause of the crisis is

[1] *Unemployment*, pp. 60, 67, 92.
[2] *Unemployment*, p. 60.
[3] *ibid.*, pp. 60–2.
[4] *Unemployment*, pp. 61–2.
[5] *General Theory*, p. 370.

> "not primarily a rise in the rate of interest, but a sudden collapse in the marginal efficiency of capital . . . particularly in the case of those types of capital which have been contributing most to the previous phase of heavy new investment." [1]

This was precisely the point that Hobson had made.

Hobson differed from Keynes to the extent that he thought that, after the crisis period, interest rates would be likely to fall.[2] His analysis of the capital market during this period was rather crude, though it did not stop him from getting the correct answer. He considered that any firm with genuine opportunities for real investment would have no difficulty in raising money at low rates of interest, but that real investment on the whole would collapse because of the obvious excess capacity in the majority of established industries.[3] Low rates of interest would not "make possible all sorts of enterprises hitherto unprofitable."

> "Though cheap investment money and cheap bank credits are helpful when for other causes recovery begins, experience shows that until definite signs of recovery have appeared in the shape of rising prices and increased orders, cheap money has very little influence in promoting recovery." [4]

His general argument on the short run collapse in the demand for new capital goods was accepted by Durbin [5] although he differed from Hobson on other matters. Later writers have clarified the theoretical point by showing that any expansionary effect due to lower interest rates could be obliterated by the shift in the investment demand schedule caused by the collapse of consumer demand.[6]

[1] *General Theory*, pp. 315, 316.

[2] *E.*, p. 411.

[3] *Investment*, pp. 84–8 ; *I. S.*, p. 274 ; *Unemployment*, p. 134 ; *R. U.*, p. 60 ; *E.*, p. 409–12. The statement (*Unemployment*, p. 135) that capital would not be available seems to have been a slip since it is clearly contradicted in his earlier and later works.

[4] *E.*, p. 411.

[5] *op. cit.*, pp. 101–2.

[6] Neisser, "General Overproduction," *Journal of Political Economy*, 1934, p. 447 ; Lange, *op. cit.*, p. 24.

IV.

This survey of Hobson's contribution has necessarily been restricted to a description of the main content of his theory. To the extent that he anticipated later developments his theory is naturally open to all the relevant criticism of the later work, which it would have been superfluous to include here. Though it has been impossible to convey adequately his deep understanding of economic processes it must be admitted that the formulation of his theory was rather crude, it being set out too often in the language of journalism rather than of science. For this defect his exclusion from academic life and discussion must be blamed which denied him the environment needed for the rigorous development of his theories.[1] Despite his faults of exposition he presented a complete theory of the cycle in the sense that the whole recurrent sequence of prosperity and depression was explained in terms of a basic set of hypotheses. Whilst the core of his theory consisted of the real factors of the variable savings-income ratio and the capital-consumption relation his theory also depended on psychological influences to a greater degree than he believed to be the case. In periods of prosperity rising prices generate a mood of optimism which leads to the automatic investment of new savings ; in periods of falling prices there is a complete reversal of mood and general pessimism induces a widespread hoarding of new money savings and a refusal to contemplate new investment. But this reversal of mood is not an arbitrary hypothesis, it follows inevitably from the structure of his model, the causal link being the excessive capital accumulated in prosperity. It will be evident from the cited references that his theory developed over time. Though substantially complete in 1910 the analysis of depression was refined in his later expositions. This makes it difficult to understand why his analysis of over-saving should have been over-stressed and his discussion of under-saving neglected.

Whilst it is undeniable that Keynes provided a more rigorously developed framework for the analysis of unemployment than Hobson did, it is nevertheless arguable that their

[1]See his *Confessions of an Economic Heretic*, London, 1938, Chapter 7.

basic explanations of the causes of unemployment in depression were remarkably similar. Each argued that full employment was impossible because it would involve a volume of savings in excess of what could be absorbed in private investment. For Keynes, sufficient investment was impossible because it would involve the "prospective profit falling below the standard set by the rate of interest."[1] Hobson arrived at the same answer with some emphasis on the imperfection of the capital market :

> " . . . in depressed times the few opportunities for profitable investment are kept in the hands of a knowledgeable group who prefer to find a profitable use for a limited amount of their own capital than to admit a flood of outside capital at a lower rate [of interest] . . . After the "break in prosperity" has passed into a long and deep collapse, the low interest testifies to the abundance of investment capital and bank credit available for any enterprise which can show the probability of working at a profit." [2]

Keynes' criticism of the "root of Hobson's mistake" seems to have been quite invalid.

The origin of this unwarranted criticism is doubtless to be found in their difference of approach to the problem. Hobson analysed the problem of unemployment directly in terms of the dynamic aspects of growth in a progressive economy. Keynes' analysis was primarily static in character, the static concepts being later used to provide a sketch of the cycle. Possibly, as a result of this static approach, he overlooked in his criticism of Hobson the feature he had noted himself, *viz.*, that the cause of the inadequate demand for new investment in depression was grounded in the events of the previous boom. Hobson did not overlook this important point. He may have seen the truth "obscurely and imperfectly" but he seems to have seen it more completely than Keynes realised.

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[1] *General Theory*, p. 370.
[2] *E.*, p. 410.

"Straddling" between Commodity Futures Markets

A recent article by Mr. B. S. Yamey (*Manchester School*, October, 1951) investigated the use of the former Liverpool Cotton Futures Market for "hedging" as an insurance against price fluctuations in the spot market. Another source of dealings in that market deserving some attention was that of "straddling," *i.e.* international arbitrage between Liverpool and other cotton futures markets, which would take place whenever prices for a given future month, compared at current exchange rates, became divorced from their normal relationship. The effects of local variations in supply and demand for futures contracts were thus diffused by purely notional arbitrage since such contracts very rarely became transactions in actual cotton. Apart, however, from the mechanism of any stabilising effect, such dealings are of interest for their effects on the Balance of Payments since they involved access to foreign exchange, and, as will be shown below, the net profit to the operator given convertible currencies does not measure the gain or loss of foreign currency to a country possessing such a market. The exchange effects of any single class of such commercial dealings tend to be somewhat neglected : discussion of the factors determining exchange flows concentrates first on visible trade, broken-down in Customs returns, then on invisibles such as shipping costs, etc., which are fairly easily imputed to specific sectors, but items such as straddling gains and losses are often lumped together in a "miscellaneous" column : if mentioned at all they are usually implicitly treated as neutral effects. It may, therefore, be worth while to attempt to evaluate the effects of such trading on exchange flows. Unfortunately, it is impossible to do so by examination of market statistics, since straddle contracts were not classified separately from other futures dealings ; in the absence of such statistical verification this paper suggests an analysis which may give at least qualitative guidance to the exchange effects of such dealings, illustrated from the pre-war Liverpool market. (In the present

economic position, it might also be useful if such an analysis could indicate effects in terms of individual currencies as well as the general balance of sterling against all foreign currencies. With the emergence of the dollar gap and the increasing doubt as to the prospects of its early disappearance, many of our foreign trade institutions must be re-examined with regard to their contributions not only to the overall balance, but also bilaterally to the sterling-dollar account : wherever hard currencies have to be lost to gain others, the burden of the world-wide dollar scarcity is merely transferred to sterling).

Straddling, then was carried out between the futures rings of world cotton markets, in which contracts for delivery of standard cotton in specified future months, up to two years ahead, were bought and sold under highly competitive conditions. The main function of these markets was to provide "hedging" facilities to the local cotton trade, but their price quotations were sensitive barometers of supply and demand in each market and provided opportunities for arbitrage operations. Between any two such markets there was at any time an "appropriate" difference in prices for delivery in any one month (compared at current exchange rates). These differences existed, *e.g.*, between markets in producing and importing countries, since the price in the latter would normally be higher by an approximation to transport costs : again, between two producer markets there might be quality differences, *e.g.* between American and Egyptian cotton since the latter was, other things equal, more valuable to spinners. Given the appropriate difference between two markets, if at any time their prices differed by more or less than this, straddling operations would take place. The operation was carried out in two stages with two transactions at each stage : first, when one market was *relatively* dear in a given month a futures contract was sold there and a similar contract simultaneously bought in the other (cheaper) market ; later, when the price difference was once more appropriate, the two contracts were reversed. The net profit was then made up of the algebraic sum of the results of the two transactions, one in each market, but depended only on the amount by which the price-difference

had altered, as will be seen from a simple example : take markets A and B, their prices for a given month being a and b. A's price should normally exceed B's by x, the appropriate difference, *i.e.* $a - b = x$. On day 1 prices are out of line, *e.g.* $a_1 - b_1 = x + dx$, so that A is relatively dear ; the straddler therefore sells in A and buys in B. By day 2 the appropriate difference has returned, *i.e.* $a_2 - b_2 = x$, and the dealer buys in A and sells in B, thus liquidating his original contracts.

Then, profit in $A = (a_1 - a_2)$ per unit.
profit in $B = (b_2 - b_1)$,,
Total profit $= a_1 - a_2 + b_2 - b_1$
$= (a_1 - b_1) - (a_2 - b_2)$
$= x + dx - x = dx$, the original departure.

It will be seen that a given total net profit might be made up of a profit in each market, or an actual loss in one offset by a greater profit in the other, depending on how the price has moved in each. These price-movements may be due to either or both of two factors : (1) the process of adjustment towards the appropriate difference, since the two markets move relatively : (2) fluctuations in the general price-level unconnected with the straddle-adjustment. Further, given the division of the total net profit between the two markets, each part will be in a different currency, so that a dealer who desires all his profit in his own currency would normally have a net profit (or loss) in what was to him a foreign currency, involving an exchange transaction for at least one "leg" of the straddle, the amount of which would be determined by the price-movement in that market.

Whenever such operations take place therefore, they may involve a net gain or loss of foreign currency to the exchange authorities of a country possessing such a market, and this flow would not be reflected in visible trade figures as would be the case in arbitrage involving actual goods. It will be seen that there are, *a priori*, three major factors determining the amount and direction of exchange transactions involved in a straddle : (*a*) the domicile of the straddler, on which depends the currency in which the profit is ultimately required :

(*b*) the proportion in which each market carries out the adjustment towards the appropriate difference : (*c*) the amount by which the general price-level changes. The exchange effects of all straddles in a given period will be determined by the balance of these flows. It is suggested, therefore, that examination of the ways in which these three factors affected exchange flows may give some indication of the conditions under which favourable or unfavourable effects on the Balance of Payments could be expected by a particular country possessing a futures market, and knowledge of these conditions, in the light of known market relationships, may give a presumptive net long-term effect for a given market in a given period.

The starting point is a series of straddles under a set of basic assumptions about the three major determinants, given which there would be equality of currency flows. Each determinant will then be analysed in turn, and the effect on exchange of variations from the condition assumed in the basic case evaluated, other things equal. If anything is known about the direction in which the greater weight of straddling in a given market departs from the basic assumption with regard to any one determinant, then that bias can be put down as a favourable or unfavourable effect, *other things equal.* The results of the removal of all the assumptions can then be combined. The set of straddles examined will be those covering two futures markets, X and Y, between whose prices there is a given appropriate difference due to quality differentials or transport costs so that the price in X should be greater than that in Y. In order to simplify the analysis it will be necessary to make two major assumptions : (*a*) that all straddles are accurately successful, *i.e.* the price-difference always returns to that appropriate, no more and no less, after a departure which has called forth straddle contracts : (*b*) only two currencies are concerned, *i.e.* all dealers are native to either X or Y markets and desire their profits in their own currencies. Any conclusions must be examined in the light of the validity of these assumptions.

A series of straddles, then, would produce equal currency flows if (*a*) an equal weight of straddling were carried out by operators native to *X* and *Y* respectively : (*b*) the adjustment to the appropriate difference after a departure were equally shared by the two markets : and (*c*) the price level remained steady so that the only price-changes were due to the straddle-adjustment. (With regard to assumption (*a*), and hereafter, "weight" of straddling takes into account not only the number of contracts but also the magnitude of each, so that one operation involving 1,000 bales and two of 500 bales each are of equal weight : in addition, variations, as between individual straddles, in departures from the appropriate difference can be subsumed under this heading).

The neutral effects on currency flows of these three assumptions can be illustrated arithmetically, using the phraseology of the cotton market in which futures are quoted in pence (or cents etc.), and hundredths (points) per lb. of standard cotton. The prices in *X* and *Y* will be compared in common units at current rates of exchange, and if the price-difference is not appropriate there will be an opportunity to straddle. There are two possible "basic" cases ; the actual

CASE 1 (BASIC CASE)

	Case 1(A) (Wide Straddle)		Case 1(B) (Narrow Straddle)	
Price	X 2,000	Y 1,500	X 2,000	Y 2,100
Straddle operation ...	Sell	Buy	Buy	Sell
Adjustment to appropriate diff. (equally shared by two markets)	— 150	+ 150	+ 150	— 150
Final Price	1,850	1,650	2,150	1,950
Liquidation of straddle ...	Buy	Sell	Sell	Buy
Net gain in each market ...	+ 150(*x*)*	+ 150(*y*)*	+ 150(*x*)*	+ 150(*y*)*
Total profit	+ 300		+ 300	

* *The small letters denote in which currency (that of X or Y) the loss or gain is incurred.*

difference may depart either by *X* being too far above *Y*, (a "wide" straddle) or not far enough above (a "narrow" straddle). Let us take the cases where *X* price for a given month is 2,000 points per lb., the appropriate difference is 200 points (*i.e.* price in *X* should be 200 above that in *Y*), and the departure in each direction 300 points (*i.e.* the actual differences between the prices for that month are 500 and — 100), so that an adjustment of 300 is required, yielding a net profit of 300 points per lb.

If the series of straddles fulfilled the three conditions above *i.e.* equal weight carried out by *X* and *Y* dealers, equal sharing of adjustment, and steady price-level, the profits made by *X* dealers in *Y*, and converted into *X's* currency, would be exactly offset by the profits made by *Y's* dealers in *X* and converted, and there would be no net gain or loss of foreign currency by either country. Now, if each of the three assumptions is removed in turn, and the effects of departures from each on currency flows examined with reference to specimen straddles similar to those in the basic case, it should be possible to assess the effects of such departures by comparison with the basic case. If then for any two actual markets there is reason to believe that there was a greater weight of straddling on a departure in one direction, then the net effect of that bias can be put down as favourable or unfavourable to one or other currency. The effects will be stated in terms of the currency of the market which should normally be higher, *X*, with an implied opposite effect on *Y's* currency.

It will be noticed that in the basic case there is no difference between the results of narrow and wide straddles, other things equal, but wherever in the analysis their exchange effects differ this must be taken into account.

Removing the assumptions singly now :

Assumption (a). That an equal weight of straddling is carried out by dealers requiring their profits in each currency.

The results of departures from this assumption are fairly obvious : if dealers requiring their profits in *X's* currency carry out a greater weight of straddling than those of *Y* then,

other things equal, *X's* dealers will take more profit out of *Y* than *Y's* dealers will take out of *X*. A predominance of straddles initiated by natives of *X* is therefore favourable to *X's* currency, a predominance of *Y's* straddles is favourable to *Y's* currency.

Assumption (b) : adjustment equally shared.

The basic cases 1 (*A*) and 1 (*B*) were midway between the two extreme cases of the adjustment falling entirely on *X*, and entirely on *Y*. When the whole adjustment falls on one market, other things equal, then the entire profit is made in that market, *e.g.* if *X* bears the whole adjustment :—

	Case II(A) (wide)		Case II(B) (narrow)	
Original Prices	X 2,000	Y 1,500	X 2,000	Y 2,100
Straddle	Sell	Buy	Buy	Sell
Adjustment	— 300	Nil	+ 300	Nil
Final Prices	1,700	1,500	2,300	2,100
Liquidation...	Buy	Sell	Sell	Buy
Net Profit	+ 300(*x*)	Nil(*y*)	+300 (*x*)	Nil(*y*)
Total Profit	+ 300		+ 300	

In this case, where *X* bears the whole adjustment, the results are unfavourable to *X's* currency since *X* operators have no profits in *Y* to convert into *X* currency, while *Y* operators have their total profits in *X* to convert into *Y*. Similarly, if *Y* bore the whole adjustment the results would be unfavourable to *Y* compared with the basic case. It may be concluded that if one market tends to adjust more than the other, all other things equal, then the effect of that disparity is unfavourable to that market's currency. Such a conclusion does not require exactly the same proportion of the adjustment to be carried out by each market in every straddle : so long as one market is observed to adjust more in general there is a presumption that the effect is unfavourable.

The results of narrow and wide straddles are again, other things equal, similar.

Assumption (c). That the price level is constant.

We now examine the results of straddles, otherwise similar to the basic cases, in which the price-level changes during the life of the straddle. Four cases can be distinguished, according to whether the straddle is wide or narrow and whether the price-level rises or falls. In the examples a price-level change of 400 is superimposed on the straddle-adjustment.

III. PRICE-RISE OF 400

	III (A)		III (B)	
	X 2,000	Y 1,500	X 2,000	Y 2,100
Straddle	Sell	Buy	Buy	Sell
Adjustment	— 150	+ 150	+ 150	— 150
Price-level change ...	+ 400	+ 400	+ 400	+ 400
Final Price	2,250	2,050	2,550	2,350
Liquidation...	Buy	Sell	Sell	Buy
Net gain in each	— 250(*x*)	+ 550(*y*)	+ 550(*x*)	—250(*y*)
Total Profit	+ 300		+ 300	

IV. PRICE FALL OF 400

	IV (A)		IV (B)	
	X 2,000	Y 1,500	X 2,000	Y 2,100
Straddle	Sell	Buy	Buy	Sell
Adjustment	— 150	+ 150	+ 150	— 150
Price-level change ...	— 400	— 400	— 400	— 400
Final Prices	1,450	1,250	1,750	1,550
Liquidation...	Buy	Sell	Sell	Buy
Net gain in each	+ 550(*x*)	— 250(*y*)	— 250(*x*)	+ 550(*y*)
Total Profit	+ 300		+ 300	

(In these cases, there is a possibility of a dealer incurring a loss in one of his markets. In each case the net profit is the same so that there is equal economic inducement to straddle).

It will be seen that Cases III (B) and IV (A) are unfavourable to the currency of X, since X operators make less of their net profit in Y, and Y operators make more of their net profit in X, than in the basic case ; similarly Cases III (A) and IV (B) are favourable to currency X. It may be concluded that, for the currency of X, a greater weight of straddling on narrow straddles than on wide is unfavourable in a price-rise and favourable in a fall, other things equal, and a greater weight on wide straddles is favourable in a rise and unfavourable in a fall. Note that these conclusions hold whatever the nationality of the straddler ; any factor which causes a greater proportion of a given total net profit to be made in one market is unfavourable to the currency of that market, since a "home" dealer would take less out of the foreign market, and a foreign dealer more out of the home market, than in the basic case.

The three sets of conclusions from the effects of varying each of the major determinants in isolation can now be applied to straddles between any two markets. If statistics were available, it would be possible to carry out a series of sample surveys on various market combinations at chosen periods, but that is not possible. Nevertheless, the "futures ring" of a cotton market is a small place, and little escapes an experienced dealer. It is, therefore, proposed to illustrate the analysis by the results of questioning several former Liverpool traders on the character of straddles between Liverpool and New York in the immediate pre-war period. Liverpool corresponds to market X where the price should be higher by shipping costs, and the results can be stated in terms of sterling and dollars. Any conclusions from this application of the analysis, of course, stand or fall by the empirical observations of the traders, but sufficient agreement was secured to justify their acceptance as fair approximations.

First, however, it is necessary to examine the grounds of the two sweeping assumptions made to obtain a working model of a straddle, *i.e.* that all straddles are successful, and that only two currencies are involved with regard to this particular pairing. The assumption of the success of all straddles implies that there was such a thing as a specific appropriate difference.

This is a rather nebulous concept : it was dependent on shipping costs or quality differences, but it was not exactly equal to them : in the sense used here, as an index to possible profits, it is more accurately described as a range and there would be certain personal variations between traders, so that some would require a rather larger departure than others to induce them to trade. These individual variations, however, were probably small : straddling was only carried out by, or on the advice of, expert traders so that there was little speculative element in the uninformed sense. Given a reasonably stable period during which the factors producing the appropriate difference do not change, it is suggested that the assumption that these straddles between Liverpool and New York were successful is a fair approximation : few straddles were absolutely successful in the sense that the exact difference expected came about, but since the appropriate difference was partly an idea in the minds of traders based on experience, it seems fair to assume that a large part of over-success and under-success would cancel out. In any case, for a qualitative conclusion which as is all that is possible in this analysis, in so far as the difference altered *towards* that appropriate during the life of the straddle, then, other things equal, the results are still valid qualitatively : only when it actually departs further from that appropriate will the conclusions be affected, and then only with regard to that part of the composition of the profit due to the adjustment ; *e.g.* the price-level effect would be unaltered. On the other hand, whenever the appropriate difference itself changes considerably, as would happen with the imposition of export taxes or subsidies, or large exchange-rate variations, all straddles actually in being at that time are affected in a direction which can only be calculated in the specific cases. The effects of such large-scale instantaneous changes will be excluded from the illustrations below. With regard to the assumption that only two currencies are concerned, it is suggested that this is a fair approximation to the facts in Liverpool-New York straddles : only a relatively very small proportion of such dealings were initiated by dealers outside the two markets concerned, though of course it was

possible for others to do so; generally speaking, foreign operators' profits in Liverpool from these straddles were converted to dollars and *vice versa*.

The two assumptions will therefore be retained in examining this set of straddles. The departures of the three determining factors in this series were ascertained by questioning several former ring-traders of considerable experience. There was a considerable measure of agreement as to the incidence of the weight of straddling with a few individual deviations on specific points, and rather less agreement as to the reasons for the characteristics noted. It was emphasised that what was required was not what *might* happen in any one straddle, but the proportions of the weight of straddling in all taken together, over a long period which might include wide individual variations. The empiric observations were as follows :

(*a*) *Sharing of Adjustment.*

The concensus of opinion is that Liverpool carried out a greater share of adjustment, in general, than did New York. This is explicable by the relative strengths of the two markets *in American cotton* : while Liverpool was the greatest pre-war consumer market, the American futures ring was only a part of it ; Liverpool handled less of the American crop than did New York and therefore tended to adjust to suit New York rather than the other way round. One trader thought that Liverpool had assumed an increasing share of the burden of adjustment during the last few decades as her share of the world crop decreased, mainly because of Lancashire's decreasing share of world textile production. The conclusion is that this factor was, other things equal, unfavourable to sterling.

(*b*) *Relative weights of straddling by sterling and dollar operators.*

It was shown that the effects of straddling, other things equal, were favourable to the currency in which the greater part of profits were ultimately required. In the case of Liverpool–New York straddles, the concensus of opinion was that the greater weight of straddling was carried out by Liverpool dealers : Liverpool was the great world consumer market and Liverpool firms the dominant straddlers. The

effect of this factor was, therefore, other things equal, favourable to sterling.

(*c*) *Price-level fluctuations.*

It was shown that when price-level changes during the life of a straddle are taken into account, the currency of market *X* (in this case Liverpool) would be affected unfavourably by a predominance of "wide" straddling in a price-fall, or narrow straddling in a price-rise, etc. The effects of removing this assumption in the basic case can be looked at in several ways : *e.g.* (1) the effect of a single steady price-rise or fall ; (2) the effects of fluctuations as such round a fairly steady long-term level ; (3) the effects of fluctuations round a long-term rise or fall.

These factors were studied in this case by asking former traders for observed distributions of straddling between wide and narrow differences, and between rising and falling markets, taking into account both frequency of occurrence of opportunity and traders' preferences both rational and irrational. Briefly, the concensus of opinion was that there was slightly greater weight of straddling on narrow differences than on wide, other things equal ; a greater weight of all on a price-level rise than on a price-level fall, while the predominance of narrow straddles was more marked on a price-rise than on a price-fall, though this last tendency is somewhat dubious. These conclusions were built up from a series of observations.

Starting with the distribution of weight between wide and narrow straddles, with regard to frequency of occurrence there was no observed tendency over any appreciable period for wide differences to occur more often or to be larger than narrow, or *vice versa*, though in any short period there might be a temporary bias. With regard to preferences, there were several observed tendencies. It should be mentioned here, that straddlers fall into two categories, though the distinction was by no means rigid : one type might be called "pure" straddlers, concerned only with the financial side and with no intention of becoming involved in the handling of actual cotton, and these would operate according to the net profit to be made alone. The operations of this type must be reckoned as having

effects proportional to the frequency of occurrence only, and if that was evenly divided as seemed to be the case here then, other things being equal, they exerted a neutral effect with regard to price-level changes and can be ignored from here on. On the other hand many dealers operated in straddles as a part only of their day-to-day futures trading on behalf of their firms, which were often large dealers in spot cotton : these "trade" straddlers had distinct preferences for certain straddles. It has been impossible to discover the relative proportions of these two types (for one thing the trade straddler might be induced by a large enough margin to desert his preferences), but it seems to be agreed that trade straddlers were not an insignificant proportion of the whole, so that their preferences must be taken into account.

The trade straddler's preference, other things equal, was for a straddle in which he went "long" in his own markets : *e.g.* a Liverpool trader would prefer a narrow straddle, when Liverpool was too cheap, which involved as a first step buying a contract in Liverpool—several traders, in fact, said that they very rarely, if ever, took advantage of a wide straddle : similarly an American dealer preferred a wide straddle. Those preferences held whatever the price-trend. This appears to be the explanation for the observation that the greater weight of straddling was on narrow straddles, since there was a predominance of British dealers. It has proved extremely difficult to discover a rational basis for this "trade" preference, but it was mentioned by too many traders to be ignored.

Given therefore that there was a greater weight on narrow straddles, the exchange effects of this on sterling would be favourable in a price-fall and unfavourable in a price-rise during the lives of straddles. There is still, however, the question of the relative strengths of these two influences. There are two reasons for suspecting that the favourable effect of a given fall would be of smaller magnitude than the unfavourable effect of a precisely similar rise. (1) In a falling market all trading, including straddles, falls off in frequency and weight due to the workings of "business confidence" ; with straddles, this can only be described as irrational since the price-difference only

is relevant, and not the absolute level, but it existed (probably more markedly the longer the period of falling prices) : (2) Another factor, which is probably less important, was a preference for straddling in a certain direction in so far as a price-change was foreseen : a dealer preferred to straddle in the cases where the market which bore the greater share of the adjustment carried out that adjustment in the same direction as the expected price-level change ; otherwise the two effects are in opposition. It will be seen that, taking Liverpool as the adjusting market, Cases III (B) and IV (A) were preferable in this aspect : the effect of such a preference could then be described as accentuating the predominance of narrow straddles in a price-rise and diminishing it in a price-fall. (This factor is probably of little consequence, since few price changes are foreseen and it is again irrational). The effect of these two factors together is to suggest that unfavourable effects on sterling in a given price-rise would be greater than the favourable effects in a fall of the same amount, such effects being more marked the longer and greater the price level changes.

Summing the effects of price-level changes on sterling, we may expect that, other things equal, (*a*) a single price-rise would be unfavourable, and a similar fall favourable to a lesser degree : (*b*) fluctuations as such round a fairly steady long-term price-level would be unfavourable, while this unfavourable effect would be increased by a long-term rising trend and reduced by a falling trend, the effect becoming favourable with a sufficiently large fall. There are too many possible combinations of circumstances to discuss here, but these appear to be the most significant. In the inter-war period, taking the long-term level as fairly steady, it must be concluded that the net effects were unfavourable.

The effects of removing each assumption in the basic case can now be combined, accepting the empirical observations of traders on the characteristics of Liverpool–New York straddles. (*a*) the effect of Liverpool adjusting more than New York was unfavourable to sterling : (*b*) the effect of a predominance of British operators was favourable : (*c*) the existence of price-level changes was probably unfavourable in the long run,

though in any one period of general decline there may have been favourable effects. In general, short-term variations from any or all of the reported distributions of straddling would have fairly well-defined effects on the sterling-dollar balance which are derivable from the above analysis, and the conditions for net gain or loss of dollars can be stated simply ; the task of estimating the actual net long-term affect is considerably more difficult since only qualitative conclusions have been reached. Only a few comments can be made on this point : it is suggested that the unfavourable effects of (*a*) were roughly of the same order as the favourable effects of (*b*) and the net effect of the two together probably fairly small (though the excess of the adjustment falling on Liverpool was fairly large, as was the excess of straddling carried on by Liverpool dealers) ; with regard to (*c*) price-level changes, the observed excesses of straddling on narrow differences and in price-rises was fairly small, certainly compared with the proportions in (*a*) and (*b*), but on the other hand their effects on exchange depended also on the extent of price-changes and these were very large : indeed the *raison d'etre* of a futures market is the existence of large fluctuations in raw material prices. The significant proportion is between the magnitudes of price-changes during a straddle and those of variations in price difference, and there is no doubt, but that the former were, even in a "normal" season, overwhelmingly larger. It should be noted here that straddles were not, as a rule, short-term operations : some might last only a few hours but the majority were carried over days, weeks and in some cases several months. It seems probable, therefore, that price-changes were the most important single determinants of exchange-flows. Tentatively, therefore, it is suggested that the net effect of these determinants together was probably unfavourable to sterling over any long period, since even if (*a*) and (*b*) together produced a net favourable effect, this would probably be more than offset by (*c*).

It is impossible to estimate the magnitude of such an outflow, since the analysis is qualitative only, and a more significant result is probably the existence of large deviations from the long-term trend in any shorter period, such as one

season or less. The price-level effect alone would probably cause considerable variations from the long-term trend, *e.g.* in seasons of shortage or glut when prices might be half or twice the previous season's level. There must have been, also, large random deviations due to other fortuitous circumstances : only the broadest generalisations could be incorporated in the assessment of any pairing of markets and even well-marked characteristics could conceal large contrary movements in the short run : the simplifications used to obtain a working model straddle merely conceal the enormous number of small unrelated factors on which exchange flows depended : finally, there was the possibility mentioned above of the appropriate difference being altered significantly by such measures as export taxes, etc., which would operate instantaneously and completely upset any straddles unliquidated at the time of imposition. It is obvious that a combination of quite fortuitous circumstances might cause considerable gains or losses of dollars, etc., say in any one season, of an order much greater than any averaged long-term loss.

To survey the total exchange effects of straddling on sterling it would be necessary now to apply the same analysis to each pairing of Liverpool with another market, and finally to estimate the results of operations by Liverpool dealers between any two foreign markets, *e.g.* Alexandria and New York, if possible taking into account the effects on individual currencies. The results of all combined might well show a net balance in favour of sterling against all other currencies but the example above shows that such a net balance might equally well conceal a loss of dollars in the long run. The example of Liverpool–New York was chosen not only because of the special importance of dollars, but also because this particular combination of markets probably gave rise to straddling of the same order as all others together, due to the overwhelming importance of the American cotton crop in total world supply and the position of Liverpool as the greatest world consumer

market. Finally it should be noted that the exchange flows examined were those due to futures trading only, and not to the market as a whole.

This paper has done no more than make a crude estimate of the exchange flows resulting from a comparatively minor feature of the pre-war international trading system : there must, however, be several such practices, some possibly still operative, which would repay further study on the same lines.

J. S. McClay

Special Financial Facilities for Industry in the Depressed Areas with particular reference to the Experience of South Wales*

From the period of the Depression until now a large, though a probably diminishing number of people have believed that the insufficiency of industrial investment in the Depressed Areas of Great Britain was largely due to the inadequacy of the ordinary methods and machinery of business finance. In the 1930's it was fairly widely believed that new financial provisions should be made for the economic development of regions where the rate of unemployment was specially high, and it was expected that the new organisations for providing financial assistance which were accordingly established would provide much new employment. This belief in the far-reaching effectiveness of new financial machinery has been undermined recently through the increasing realisation of the importance of other impediments to new enterprise in the Depressed Areas. It is nevertheless clear that certain limitations and rigidities in the money and capital markets rendered less feasible a number of industrial developments which would have had multiplier effects on economic activity in those Areas. The aim of this paper is to describe the special financial measures that were instituted, and to study in particular the scope and effectiveness of those in South Wales.

In 1934 Tyneside and Durham, West Cumberland, the Clyde Valley and most of the industrial part of South Wales were scheduled as "Special Areas." In South Wales the collapse of the basic industries in the early 1930's had followed upon a decade of low activity. Under the "Special Areas" policy efforts were made to attract new industries, particularly those of a "light" industrial character, which would both help to reduce unemployment and to diversify the economic

* Thanks are due to the Trustees of the Houblon-Norman Fund for a grant covering the cost of this enquiry.

structure of the region. The total number of unemployed people in the South Wales Special Area was halved between 1934 and 1939—falling from 110,000 in the former year to 56,695 in April, 1939[1]—but this fall was mainly due to migration from the area and to rearmament and the consequent recovery of the basic industries. Indeed, the new factories for light industries (at the Treforest Trading Estate, at Dowlais, Merthyr and Porth in the Rhondda Valley, and at Llantarnam and Cwmbran in Monmouthshire) provided work for only 3,043 people in 1939[2]—and there were 4,000 workers even then without employment in Merthyr alone.[3] Nevertheless, these enterprises provided a valuable basis for the considerable further expansion in the new industries (light and heavy) to date. The total number of people employed in the summer of 1951 in factory jobs created in the South Wales Development Area since 1937 was about 106,000 of which 68,000 were men.[4]

The new industries of South Wales (and a few enterprises in older industries also) were financed after 1934 not only by the old-established methods which had been employed to provide capital for the basic industries (*i.e.* through personal contacts, the Stock Exchange, the banks and the investment trusts) but also by a number of Special Areas Organisations. Often it was the money offered by the special organisations which persuaded firms (old and new) to establish works in South Wales; they raised the remainder of the necessary capital by the older methods.[5] Before attempting to analyse the activities of these institutions in South Wales, it will be useful to show how the demand for special financial facilities developed in the area, and to give some details about the special organisations.

[1] *The Times, Special Areas Supplement*, 27th June, 1939.

[2] It was expected in 1939 that those new factories would give work to about 9,000 people a year later apart from indirectly providing employment for several thousands more. (*loc. cit.*).

[3] *Ibid.*

[4] Round figures supplied by the Board of Trade Office for Wales.

[5] See Table II below.

THE NEED FOR SPECIAL FINANCE.

The need for increasing industrial investment in South Wales from about 1930 onwards reflected a similar need for the whole of British industry. Almost everywhere there was a reluctance to invest in industry. The Depression of the early 1930's not only reduced the means but it also sapped the will to invest, and taxation had come increasingly to penalise risk-taking. It is true that small savers were provided with, and took advantage of growing facilities for investing safely through building societies and insurance companies ; but even the most adventurous members of the lower middle-class would hardly go beyond investing in a well-established and proven company. Among the institutional investors the insurance companies were obliged, by the nature of their business, to follow a fairly conservative investment policy ; and, except to the extent that they expanded their own or subsidiary enterprises, the large firms sought to keep their reserves in a liquid form. All these were fundamental factors, and little space is given to them here only because their effects are fairly well known.

Small and medium sized enterprises at the same time found it especially difficult to raise capital. The people who invested directly in local concerns had become fewer and it was clear that small businesses would have to find some other source of finance. None of the investment houses in the City, however, would deal in such small amounts of capital as the small businesses required ; and the Report of the Macmillan Committee published in 1931 emphasised the need to create more effective machinery for the provision of long-term loans, especially to small and medium sized firms. The Committee endorsed the policy of the banks in preserving their established liquidity ratio, but it suggested that they might safely participate in the formation of new institutions for industrial finance.

All those general difficulties of raising capital were operative in the Special Areas : much of the development that took place there was new in character and a high proportion of the enterprises involved in the development, therefore, were very small and untried. Moreover, firms seeking to establish

themselves in these Areas had further problems. Enterprises in places like South Wales had already demonstrated an inability to provide adequate returns on their capital and, in addition, private investors considered such Areas unattractive because it was considered likely that the local demand for new products would be weak and because they believed that the local workers would take time to acquire the requisite new skills. If, however, the problems of raising capital for enterprises in the Special Areas were greater than those facing businesses elsewhere so too (according to most people) was the social need for establishing such enterprises. Finance was thought to be a key factor in this task. Some financial houses (for example, Hambro's Bank and Erlanger's) increasingly sought to assist firms intending to operate in the Special Areas, but in general the profit motive drove the financiers to give preference to the more numerous firms wishing to establish themselves in other regions. There was, therefore, a convincing case for the provision of finance by special means for firms in the Special Areas.

Following a series of articles on "The Stricken Coalfield" of South Wales in *The Times* in April, 1928, there was an appeal by the Lord Mayors of London, Cardiff and Newcastle-on-Tyne which brought some £750,000, supplemented by a similar amount from the Exchequer, for the relief of distress in the depressed areas and "for facilitating the movement of boys and youths to employment in more hopeful areas."[1] An appeal launched by *The Spectator* in the summer of 1932 raised a sum of about £1,700 for assisting the "Brynmawr Experiment" in South Wales.[2] All this, however, had hardly touched the problem of facilitating the establishment of new enterprises in the depressed areas.

The need for special financial facilities was realised quite soon in South Wales. The National Industrial Development Council of Wales and Monmouthshire, created in August, 1932 for "helping existing industries and the attraction of new ones,"[3]

[1] *The Times*, *loc. cit.*

[2] *Brynmawr Bulletin*, September, 1932.

[3] National Industrial Development Council, *Handbook*, 1937, p. 6.

worked from its inception for the provision of such special facilities. In the Report for 1934-35 it was pointed out that the Council's proposals for establishing special financial machinery had been submitted to the Government and the banks and to the new Special Areas Commissioners. The proposals of this Council and of similar bodies elsewhere undoubtedly had much influence in bringing to the Statute Book the Special Areas (Agreement) Act of 1936.[1]

The need for reducing distress on the northern outcrop of the coalfield in Monmouthshire had led an "Order of Friends" to launch their "Brynmawr Experiment" of community building. The aim was to form units of subsistence production and, to facilitate this, a parent body, the Brynmawr and Clydach Valley Industries Ltd., was registered in March, 1930 under the Industrial and Provident Societies Act. Capital for each of the constituent units (which would be registered separately under the Provident Societies Act) would be advanced in the form of loans by the parent society. The latter by the end of 1931 had received £4,300 in donations, an additional £3,300 from the issue of £1 shares and £900 from the issue of loan stock.[2] The activities of these groups of Quakers from 1930 onwards undoubtedly helped to bring the capital requirements of the distressed areas to the attention of a wider public.[3] One of their later organisations, the Subsistence Production Society of East Monmouthshire, qualified for assistance from the Commissioner for Special Areas in England and Wales.

The suggestions put forward locally were of a diverse character though they all concentrated attention on the potential new entrant and thought in terms of modest amounts of money. One proposal was for an independent investment

[1]See below p. 46.

[2]Peter Scott, "Community Building" (reprinted from *The Friend*), *Brynmawr Bulletin*, February, 1932.

[3]The first *Industrial Survey of South Wales* (H.M.S.O., 1932) placed much stress on the value of the "conscious effort of local self-help." It pointed out that though the employment of fifty or sixty persons at Brynmawr was but a small contribution towards reducing an unemployment of 30,000 or 40,000 it was "a step in the right direction."

trust which would presumably be financed privately and would operate on fairly strict commercial principles. Another proposal was that one or more of the banks should make money available (to enterprises in South Wales) through the Development Council, which would use its local knowledge in administering these funds. The principal and interest should be guaranteed and any losses should be borne by the Government and the banks. A third proposal was that local authorities should be authorised to subscribe towards a central industrial loan fund which should be administered by the Development Council (itself largely composed of representatives of local authorities).[1] This proposal was a variant of an earlier scheme whereby the local authorities in Wales should form their own Co-operative Public Utility Boards.[2] The absence of any reference to rates of interest in all these schemes suggests that high rates were not an important issue at this time : the problem was a more fundamental one. It is noteworthy, however, that (judging mainly by the lack of reference to the topic in parliamentary debates) the Welsh Members of Parliament—with the notable exception of Mr. Temple Morris, then M.P. for a Cardiff constituency—showed no realisation of the need for special investment measures in the early 1930's.

By 1935 opinion in South Wales had crystallised further in favour of special financial facilities. One of the aims of the *Second Industrial Survey of South Wales* begun in that year by members of the University College of South Wales, Cardiff was "to report upon methods whereby finance has been found for newly established firms in the Region during the past five years, and the experience of special financiers, such as Credit for Industry Limited in providing finance for small concerns." The *Second Survey* published in 1937, however, seemingly because of the "incomplete information available," did not say much about financial facilities ; [3] but it drew attention to capital needs in a number of special cases. It made a plea for

[1]G. Williams (Chairman of N.I.D.C.) in *Western Mail*, 1st November, 1933, and 21st February, 1935.

[2]Saunders Lewis, *Local Authorities and Welsh Industry* (Welsh Nationalist Party, 1934).

[3]cf. *op. cit.*, 1937, Vol. III, pp. 336–340.

considering whether special facilities for the raising of capital, "in larger amounts than are permitted by the Special Areas Reconstruction Association," should be made available for firms establishing suitable industries in Merthyr.[1] It advocated special financial assistance for the establishment of new laundry, cleaning and aluminium refining enterprises, and for the expansion in South Wales of the industries of wool, paint, chemicals, confectionery, fishing and gas.[2]

The investigators who prepared the Second Industrial Survey were reporting fairly soon after the establishment of the Special Areas Reconstruction Association Ltd. (mentioned below as S.A.R.A.) and they awaited information about results emanating from it, but they pointed out "that no *special* aid is available to float large new industries." This seemed to them a serious gap since they believed that what was required was "the initiation of one or two large industries" for which there was special opportunity or social need.[3]

It is clear that, in the words of the Commissioner for the Special Areas in 1937, there was in South Wales as in the other depressed areas "still a gap, namely the furnishing of capital to enable a project to be started and brought to the point of qualifying for assistance from the channels now existing." [4]

THE MACHINERY OF SPECIAL FINANCE.

The policy evolved from 1934 onwards for attracting new enterprises into the Special Areas included the making of contributions towards the rents, taxes and rates payable on the new undertakings that were established there. No attempt is being made in this paper to consider that particular part of the policy of assistance in South Wales; and it is even doubtful whether sufficient information could be collected to enable a general assessment of it to be made.

The other parts of the policy were the making of special arrangements to provide capital for enterprises intending to

[1] *Ibid.*, p. 213.

[2] *op. cit., passim.*

[3] *op. cit.*, pp. 338–9.

[4] *Report of the Commissioner for Special Areas in England and Wales.* Cmd. 5595, para. 265; Cf. S.A.R.A. stipulations described below p. 47.

establish themselves in the Special Areas and the provision of factories to be let at low rents. Both of these complementary sections of the policy can be investigated fairly fully.

The Special Areas (Development and Improvement) Act of 1934 established the two offices of Commissioners of Special Areas for England and Wales and for Scotland to initiate and assist "measures designed to facilitate the economic development and social improvement of the Areas."[1] The Commissioners were precluded from providing financial assistance to business enterprises conducted for profit; but it was under the aegis of the Special Commissioners' Offices that the non-profit-making Trading Estate companies functioned.

In June, 1936, under the authority of the Special Areas (Agreement) Act of 1936 the Special Areas Reconstruction Association Ltd. (S.A.R.A.) was incorporated with the main object of providing temporary financial facilities to businesses of an industrial character in the Special Areas. S.A.R.A. had a nominal capital of £1 million, consisting of 900,000 Redeemable $3\frac{1}{2}\%$ Cumulative Preference Shares of £1 each and 100,000 Ordinary Shares of £1 each. The whole of the 900,000 Redeemable Preference Shares were taken up by about 200 subscribers comprising leading investment trusts, insurance companies and industrial undertakings. The Ordinary Shares were subscribed by fourteen banks headed by the Bank of England, which took 40 per cent.

Of the Preference Share Capital 1/- per share or £45,000 was paid up at the allotment in June, 1936, while the whole of the £100,000 Ordinary Share Capital was paid at the same date in full. For the first three years of S.A.R.A.'s activities it financed its loans by means of Bank Overdrafts, which at the 31st March, 1939 amounted to some £444,000. In June, 1939, however, a further 10/- per share was called up on the 900,000 Cumulative Preference Shares of the Company, and out of the proceeds of this call the Overdrafts were extinguished.

[1]The First Commissioner for the Special Areas of England and Wales was Sir Malcolm Stewart, who was followed in November, 1936, by Mr. George M. Gillett. District Commissioners serving without remuneration were also appointed, and Captain Geoffrey Crawshay served for South Wales.

The original Directors of S.A.R.A. were Lord Portal (Chairman), The Hon. Evelyn Baring, Messrs. Frank Hodges, Edward de Stein, James G. Weir, J. Gibson Jarvie and Maurice S. Gibb (Managing Director).

Under an Agreement made between S.A.R.A. and the Treasury the latter undertook to reimburse the former's administration expenses (limited to a maximum of £20,000 per annum) and also to pay all its preliminary expenses, as well as the costs and expenses of its winding-up. In addition the Treasury agreed to provide the Company with the sum of £100,000 as a capital reserve against bad debts, and undertook that upon the winding-up of the Company they would recoup all losses of capital attributable to the first £1 million of loans made by the Company to an amount not exceeding one quarter of the amount of such loans, and further all losses of capital attributable to any loans made by the Company in excess of £1 million, limited however to 25 per cent. of such additional loans. The Bad Debts Reserve of £100,000 was duly provided by the Treasury, who also recouped S.A.R.A.'s administration expenses, which averaged about £12,000 per annum during the period of the Company's active existence.

The Memorandum of Association of S.A.R.A. stipulated "that no loan, or loans to any one Company . . . shall exceed £10,000 or be repayable over a period exceeding five years except with the previous consent in writing of the Treasury." S.A.R.A. was thus primarily designed to assist small business. It placed great emphasis on the provision by the assisted companies themselves of a large proportion of the total capital, and it was made clear to applicants that the Association could not be the predominant partner in any undertaking.[1] It was later emphasised that the applicants themselves were contributing "a substantial proportion" of the total capital of the firms which obtained loans from S.A.R.A.[2] A local Board was set up in South Wales (as in other Areas) to give the Association "the benefit of local knowledge." [3]

[1] *Hansard*, 8th February, 1937, Col. 162.

[2] Chairman's Speech, 1939.

[3] The members of this Board were Messrs. A. T. James, K.C., Chairman (until his death in 1940), Edmund L. Hann, D. Morgan Rees, G. E. Aeron-Thomas and Aneurin Davies.

On the 31st July, 1945, S.A.R.A. went into voluntary liquidation as a solvent Company and the liquidation is now (February, 1952) all but concluded. The whole of its subscribed share Capital has been repaid and it has needed substantially less than half of the £100,000 Bad Debts Reserve provided by the Treasury. No payment will have to be made by the Treasury in respect of the guarantee of losses on loans referred to above.

In December, 1936, Lord Nuffield vested the sum of £2 millions in Trustees [1] with very wide powers for its use for the benefit of the Special Areas. It was decided to use this sum mainly to provide industrial capital and the flexible terms of the Trust enabled the fund to be used either to provide loan capital or to take up share capital or even to make free grants. The Nuffield Trust differed in this respect from S.A.R.A. and the Treasury (see below) which were restricted to making loans.

By the Special Areas (Amendment) Act of 1937 the Treasury were authorised to provide loans for any enterprise established in a Special Area after 6th May, 1937, and which employed ten or more persons.[2] A sum of £2 millions was made available as a Fund administered by a Statutory Committee for this purpose.[3] Like the Nuffield Trust the Treasury were empowered to provide finance for larger projects than those sponsored by S.A.R.A. Since the repeal of the Special Areas Act the Treasury has acted on the advice of a Statutory Committee (under Section 4 of the Distribution of Industry Act, 1945) as a lender of last resort to undertakings established or being set up in the Development Areas (which include the old Special Areas—with important extensions in the case of South Wales).

[1]Sir Nigel Campbell, Lord Portal and Mr. Seebohm Rowntree.

[2]It is by no means a new thing for the Treasury to assist in providing finance for private industry. The Solicitors of the Board of Trade and the Treasury appear for example as the trustees for debentures up to £370,000 issued in 1918 by the National Smelting Co. Ltd. on its Bristol property (cf. the Company's files at the Companies Registration Office).

[3]The Statutory Committee consisted of Lord Portal, Sir Nigel Campbell and Sir Frederick Marquis.

It is a well known fact that the three organisations just described worked together very closely in providing financial assistance,[1] and it was also useful that the post-war Development Areas Treasury Advisory Committee had personal links with the previous Special Areas Organisations.[2]

General Account of the Special Finance made available to South Wales Enterprises.

Up to the end of 1947 the amounts which had been provided by the three Special Areas Authorities in assisting industry in South Wales was as follows :—

	Loans	Shares
	£	£
By H.M. Treasury (under the Act of 1937) ...	595,000	—
By the Nuffield Trust	521,181	316,000
By the Special Areas Reconstruction Association Ltd.	214,250	—
Totals	1,330,431	316,000

In addition the Nuffield Trust made free grants for training purposes totalling £19,000. Since 1947 the Nuffield Trust have also made further temporary loans to assisted undertakings amounting to £80,000.

The allocation of the loans and share contributions between various industrial categories up to 1947 is given in Table I. It is shown there that a quarter of the total went to assist the older basic industries. S.A.R.A. did not provide any finance for them and, therefore, it was throughout a diversifying influence on the economy of South Wales—though each of the other authorities provided more money than S.A.R.A. for the new industries. The Treasury was the main supporter of the textile and clothing enterprises and the only source of special finance for aluminium melting ; the Nuffield Trust was the main provider of special finance for the light engineering firms. Of the total special contribution made by the three bodies, over a third (£675,000) was money lent, by the Treasury and the

[1]Cf. S.A.R.A. Chairman's speech notes for 1938 (London School of Economics Library).

[2]*Second Report from the Select Committee on Estimates*, 1946–47 : *The Administration of Development Areas*, p. 4.

Nuffield Trust, to three undertakings—for aluminium melting, coal carbonisation and wheel and axle production.

TABLE I

CAPITAL PROVIDED BY THE SPECIAL AREA AUTHORITIES UP TO 1947 FOR VARIOUS INDUSTRIAL GROUPS IN SOUTH WALES *

	Nuffield Trust	Treasury	S.A.R.A.	Total
	£	£	£	£
Coal and Coal Carbonisation : Iron and Steel	228,500	162,500	—	391,000
Aluminium Melting	—	200,000	—	200,000
Metal Ware and Other Metal Processing	66,531	27,000	41,500	135,031
Engineering	291,000	30,000	48,000	369,000
Textile and Clothing... ...	106,500	135,500	7,500	249,500
Miscellaneous	144,650	40,000	117,250	301,900
Total	837,181	595,000	214,250	1,646,431

** Thanks are due to Mr. J. A. Roney, of the Nuffield Trust, who provided statistics for compiling this table and who has given his advice generously on a large number of matters connected with this paper.*

Of the loans made by the Treasury, amounting to £595,000, £483,000 in round figures (or about 80 per cent.) had been repaid by the end of the year 1950. Of the S.A.R.A. loans, amounting to £214,250, £184,844 (or 86 per cent.) had been recovered by the end of 1950; the balance, amounting to £29,406, had been written off as lost. Of the £917,181 provided by the Nuffield Trust by way of loans and subscriptions for shares there had been recovered by the end of 1951, £455,250 on account of loans, while realisations of shares had produced the sum of £122,244, which included over £10,000 profit on realisation. Of the remainder, £82,402 had been written off as irrecoverable at December, 1950 and much of the balance still outstanding is unlikely to be fully recovered.

The rates of interest charged by the three Special Areas Organisations were mostly in the 4-4½ per cent. range, and the

Nuffield Trust shares were mainly of a 5 per cent. non-cumulative Preference type. It was the common practice, in cases where the three institutions co-operated and where special risks had to be undertaken, for the Nuffield Trust to shoulder the greater risks.

It is interesting to find the proportions of the total financial facilities made available by these three bodies which went to South Wales. The finance made available by S.A.R.A. to enterprises in this area was 27 per cent. of the total loans made by it up to 1941 and 28 per cent. up to 1945 when the process of its dissolution began.[1] The Treasury devoted 51 per cent. of the £1,160,500 which they advanced under the Special Areas Act of 1937 to assisting industry in South Wales, and about 38 per cent. of the total Nuffield finance of about £2,240,000 went to South Wales.[2]

Apart from the special finance described in Table I other special contributions to capital were provided. Following the donations made privately to the Brynmawr Order of Friends in the early 1930's, the Commissioner for the Special Areas in 1936-37 made available grants up to £82,500 for the Eastern Valleys Subsistence Production Scheme, which was under the wing of the Order of Friends. Private donations of "approximately £38,000" were made to that scheme ; and £30,000 of this amount was given by Lord Nuffield.[3] It is not clear how much of the £82,500 granted by the Commissioner was taken up. The Scheme, which was designed to supplement the income of the older employed men did very valuable work but despite all the special financial assistance which it received it failed to become self-supporting. A further £28,000 from the Special Areas Fund was provided in 1936 as a loan to the Brynmawr and Clydach Valley Industries Ltd., which owned the Brynmawr furniture factory (destroyed by fire and later rebuilt) and the Brynmawr Boot Factory. (Later the Nuffield

[1]Compiled from the S.A.R.A. Chairman's Speeches.

[2]Overall figures from Cmd. 7540, *Distribution of Industry*, October, 1948.

[3]An Order of Friends, *Annual Report* 1936, p. 75 ; *Reports of Commissioner for Special Areas*, 1937, para 390 ; 1938, para. 228.

Trust assisted Brynmawr Bootmakers Ltd., for the erection of six houses for key skilled workers.)[1]

The assistance given to these Quaker industrial organisations from the Special Areas Fund superficially appears to contravene the clause debarring it from financing profit-making organisations, but it seems to have been made possible because the recipients were registered under the Provident Societies Act. Brynmawr Bootmakers Ltd., which was formed in 1937 as one of the constituent societies of the Brynmawr Experiment, was registered in 1941 under the Companies Act and in February, 1949, a debenture was issued to the Treasury mainly to replace other debentures issued in respect of loans under the Distribution of Industry Act 1945.

The preparation of factory sites and the provision of factories at reasonable rents was another part of Special Areas policy. Here the Trading Estate was used as a means (among other things) of removing some of the initial barriers due to the high overhead costs of new industrial enterprises. In 1934-6 four Estate Companies were founded for the Special Areas, and one of them operated at Treforest in South Wales. These Companies functioned under the aegis of the Special Areas Commissioners and later the Board of Trade, and for a number of years they borrowed capital from the Treasury free of interest. This freedom from interest payments was of course necessary because the Estate Companies would not have an income until their factories were occupied. The rentals charged annually for the factories were about 6 per cent. of the cost of site preparation and erection.

The South Wales and Monmouthshire Trading Estates Ltd., was established in June, 1936, as a non-profit making organisation. It had no share capital but operated on advances made by the Commissioner for the Special Areas. In April, 1946, its scope was extended and its name was changed to Wales and Monmouthshire Industrial Estates Ltd., and, under the Distribution of Industry Act, it has been financed by the Board of Trade.

[1]Order of Friends, *Annual Report*, 1938, p. 40.

Since 1936 the Company has performed two services : the development of the Treforest Trading Estate and the carrying out of other development programmes (the preparation of sites and the building of factories) for which the Company has acted as an agent for the Board of Trade. For the first task, the development of the Treforest Estate, the Company up to 31st March, 1939, received £939,272 from the Commissioner for the Special Areas. Up to 31st March, 1951 the advances from the Board of Trade (including previous advances by the Commissioner) for the work at Treforest totalled £2,604,090. The second category of activities of the Company, *i.e.* the projects other than the Treforest Trading Estates, involved the spending up to 31st March, 1945 of £450,088 ; and from April, 1945 until 31st March, 1951 the expenditure on these projects in South Wales was nearly £13,000,000.

Since the War the two private financial organisations, the Finance Corporation for Industry Ltd. and the Industrial and Commercial Finance Corporation Ltd.—both of them established in 1945—have been very useful providers of finance to enterprises in the Development Areas (as in other regions). Though they co-operate closely with Government Departments these institutions operate according to the usual principles of the money market. Beyond them are the Treasury, and they are willing to take somewhat larger risks than those which a private financial institution could contemplate.[1]

Under the Distribution of Industry Act of 1945 the Treasury have been empowered to make loans and grants to such industrial undertakings in the Development Areas as are approved by the Board of Trade (which has taken over many of the old duties of the Commissioners for the Special Areas) because they comply with the location of industry policy and seem to have a fair chance of commercial success. The Treasury must be satisfied that the applicants have already explored the possibility of borrowing from others and failed to obtain accommodation on suitable terms. It is advised in these matters of granting loans (which, where possible, are

[1]Select Committee on Estimates, 1947. Minutes of Evidence to Sub-Committee *c*, para. 35.

secured by a charge upon tangible assets) by an Advisory Committee which has valuable personal links with the old Special Areas activities and also works in consultation with the two finance Corporations. The amount of the post-war loans which the Treasury have agreed to make in the South Wales Development Areas has not been officially disclosed, but it is understood to be substantial.

More Detailed Analysis of the Financial Facilities provided by S.A.R.A., The Treasury (under the Special Areas Act of 1937), and the Nuffield Trust.

For this analysis the files of twenty-two companies from South Wales which obtained capital from the three Special Areas Organisations have been examined. The names of all the firms which were assisted remains a matter of secrecy and the identity of the twenty-two companies was inferred by relating the names of firms in the trade directories to the general information available.

These twenty-two companies received considerably more than half of the total special capital supplied by the three organisations in South Wales and it appears that they provided a similar proportion of the employment created by all the recipients of special finance. Only five of the twenty-two companies were in existence before the setting up of the three Special Areas Organisations in 1936-7; only one of them existed before 1930.

The capital structure of these twenty-two companies is set out in Table II. Here ordinary finance (by the issue of shares and by borrowing) is distinguished from special finance by borrowing and share issues and it is noteworthy that the recipient companies themselves were often careful to draw such a distinction in their records. For all the companies taken together the total amount of special finance (including the holdings of shares by the Nuffield Trust) was in 1939 more, and in 1945 less than that raised without recourse to the special institutions. It may be added that, despite the contrary aims of S.A.R.A. if not also of the other two institutions, the special loan capital alone exceeded the total

TABLE II

A SUMMARY OF THE CAPITAL STRUCTURE AND EMPLOYMENT OF TWENTY-TWO SOUTH WALES COMPANIES

(1) Industrial Categories and number of firms whose files were inspected	(2) Mid-Years	(3) Ordinary Business Capital (*i.e.* Paid up share capital plus loan capital)	(4) Shares held by the Nuffield Trust	(5) Loans from the three Special Areas Organisations	(6) Total Amount of Capital outstanding from the Special Areas Organisations*	(7) Number Employed
		£	£	£	£	
Coal Carbonisation (1)	1939	334,000	—	325,000	325,000	virtually none
	1945	334,000	—	322,628	322,628	,, ,,
Aluminium Smelting and Re-melting (1)	1939	30,000	—	—	—	266
	1945	600,000	—	200,000	200,000	105
Metal forging, hollow-ware, metal sheet and processing (5)†	1939	45,557+	45,000	207,573	252,573	ca. 345
	1945	68,886+	45,000	181,573	226,573	ca. 746
	1949		45,000	162,000	207,000	ca. 740
Engineering (2)	1939	67,470	30,000	5,000	35,000	277
	1945	37,470	30,000	35,000	65,000	455
	1949		—	—	—	624
Textile and Clothing (2)	1939	21,000	45,000	56,500	101,500	1,148
	1945	11,000	55,000	84,000	139,000	1,311
	1949	96,000	35,000	6,000	41,000	1,411
Miscellaneous (11)	1939	78,985	—	61,750	61,750	449
	1945	159,274	24,000	55,750	79,750	1,312
	1949	180,192	25,000	11,000	36,000	2,151
Total (22)	1939	577,012+	120,000	655,823	775,823	ca. 2,485
	1945	1,210,630+	154,000	878,951	1,002,951	ca. 3,929
	1949		105,000	179,000	284,000	ca. 4,926

* *The figures showing loans and shares* outstanding *at each of the dates given are less than the total contribution made by the three Special Areas Organisations for they omit the loans made* and repaid *before each of the dates. Up to the end of* 1949 £1,411,000 *had been provided by the three Special Areas Organisations for the twenty-two companies, in loans and for share purchases, and* £16,000 *in gifts for them; of the former amount* £708,983 *remained outstanding. The figure for loans and shares* (£1,411,000) *includes certain loans from the Treasury under the Distribution of Industry Act,* 1945.

† *One of the firms in this category was assisted for the establishment of a plant which was distinct from its main activities. The amount of the capital provided by the firm for this enterprise cannot be obtained—and it would be wildly misleading to include this large firm's total ordinary business capital in Column* (3).

share capital at some period for fifteen of the twenty-two companies ; and the net gearing ratios of many of these firms were increased further by ordinary loans. In most cases capital other than that supplied by the Special Areas Organisations came from the main entrepreneurs and their friends and private associates ; and in a large proportion of the undertakings it was only after the Special Areas Organisations and the private sponsors had succeeded in establishing the business that the financial houses provided additional capital.

It is not possible to show the extent of the effect the special finance had on employment, since the scale on which some of the assisted enterprises might have operated if the special finance had not been forthcoming is obviously a matter only for conjecture ; others would clearly not have been launched. Superficially, however, it would appear that the special finance for the enterprises in the textile and clothing and miscellaneous categories provided the best returns in this respect, whereas the metal firms used a relatively large amount of special capital for a small addition to the employment of the area. This result would, *prima facie*, be expected because of the much larger amount of capital needed per worker in "heavy" than in "light" industries.

The firms appear to have called for special finance for a variety of reasons. Security, or the desire to avoid leaning too heavily on banks or other institutions which might quickly withdraw their loans, seems to have been the motive in the case of at least one local firm and an émigré firm. Another firm, on the other hand, was obliged to seek a S.A.R.A. loan (which was obtained without much difficulty) because the subordinate partners would not advance more than £100 each —and they could easily have invested much more. The great success of this firm eventually enabled the special loan to be speedily repaid—and also enabled the chief promoter to buy out his partners.

The special loans to the companies were usually secured by a mortgage or charge, often on all the property, in order to give them a priority over the capital provided by the applicants. Fairly often a debenture was issued "on a lease from the South

Wales Trading Estate Ltd. and a floating charge." One example was noticed of a "Deed of Further Charge" having to be issued to strengthen the security for an earlier special loan. In the case of one recipient of special finance, a guarantee was provided by another company : two of the directors of the borrowing company obtained (for a consideration) from the other company in which they were interested an "undertaking to guarantee payment of all moneys" secured by the special debentures.

Most of the possible changes were rung by the priority arrangements for debentures. It was common for the debentures issued to S.A.R.A., the Treasury and the Nuffield Trust to have priority over those issued to private lenders. However, where a bank loan already existed and was covered by a charge, the bank was commonly left in possession of its prior position. Moreover, the applicant was always at liberty to apply to the Special Areas Organisations for consent to raise further money on an independent security (*e.g.* a contract to supply a Government Department) and this was frequently given. Debentures issued at different times to the same Special Areas Organisation most often ranked equal as a charge, but occasionally a new debenture issued to one of the three Organisations ranked second to a debenture issued to one of them or to a private lender : the practice in securing additional loans varied with the circumstances of each particular case.

The files of these companies show that, to the obvious advantage of the borrowers, no commissions were charged for the procurement of provision of special loans, whereas substantial commissions had occasionally to be paid on the acquisition of ordinary loan capital. One well-established firm of ironmasters, for example, paid as much as £4,000 in 1940 and 1941 "by commission in respect of shares or debentures or allowed by way of discount on any debentures since the last return."

The special financial facilities were primarily made available to new enterprises ; and of the twenty-two companies considered here it seems that only four had been established before arrangements were entered into for obtaining capital from the

Special Areas Organisations. This special finance was also largely provided for small firms—though a third of the total went to four large enterprises.

In the 1930's a number of English firms of established reputation were unofficially approached by Lord Portal on behalf of the Special Areas Organisations and invited to move to South Wales, because it was believed that their soundness and experience would be particularly useful in the efforts towards diversifying the industry of the Area. These firms (which would be in a fairly strong position with regard to ordinary finance) would obviously be able to claim a favourable reception for their applications for money from the Special Areas Organisations ; and it was, indeed, usual for loans of a size above the average to be granted to such firms. The representatives of a number of these firms have stated that they could not have established themselves in South Wales without the special financial assistance which was given to them.[1]

Most of the émigré industrialists who sought to establish businesses at Treforest and other places in South Wales had been engaged at home in businesses similar to those which they sought to establish in South Wales, and many of them had previously sold their goods to English customers and already had commercial contacts in England. After moving they were often able to draw on their English agents and customers not only for some of their capital but also for guidance to the sources of any additional capital which they might require. Past experience of the particular business which they sought to start in South Wales and the support of private British investors greatly strengthened their hands when they approached the Special Areas Organisations.

Some of the émigré firms which applied for financial assistance were refused accommodation, and in certain cases this must have been because the promoters were able to provide the necessary capital without assistance. A number

[1]This and the following paragraphs are based upon general information given by a number of industrialists, and the statements in them do not necessarily refer to the twenty-two companies which are considered in the previous paragraphs. I am obliged to Mr. P. J. Watkin for information about the opinions of a sample of the industrialists.

of these firms became established and made good. A firm of Czech refugees was officially advised to go to Treforest rather than to Nottingham (as originally intended) and they failed to obtain a loan from S.A.R.A. ; nevertheless they established their business at Treforest. In another case the occupation of a factory at Treforest was made a condition of the establishment of business in Britain and the business was set up on the assumption that a S.A.R.A. loan would be forthcoming. No special assistance, however, was obtained but the business developed and still continues. There is also the example of a firm which failed to get special financial assistance but which was able to start its business because of the availability of a factory at low rent at Treforest.

The fact that only a few Welsh industrialists received special loans for establishing businesses in South Wales was due to the small number of applications from such industrialists : there was certainly no discrimination by the Special Areas Organisations against potential enterprises of local origin. In South Wales the proportion of the risk capital for industry obtained from investors within the area was always small, and the Depression had further reduced the ability and willingness to invest.

Of the 22 firms whose accounts have been examined, 21 were still actively in business in 1948, and there had been a full redemption of all the special loans by 16 of them. Some at least of the firms made definite provisions for the repayment of loans from the Special Areas Organisations : one firm had a Debenture Redemption Account of £11,170 in 1943 and £13,862 in 1945, and another had one of £3,375 in 1947. This latter Company also had in 1947 a Reserve of £11,500 for the redemption of the preference shares which were all held by the Nuffield Trust. Another Company resolved and stated in 1939 that as long as it owed sums under the debenture it had issued to the Treasury (securing £10,000 and the interest thereon) "no distribution of profits shall be made to the Preferred Ordinary or Deferred Ordinary shares, but any profits which but for the provisions of this article would have been distributed

to the Preferred and Deferred Ordinary Shareholders . . . shall be carried forward into the accounts of the following year."

CONCLUSION.

The last paragraph has indicated the success in terms of financial returns of the sample of companies. How many of the 4,926 who obtained work with these sample companies, and how many of the 100,000 and more in new factory jobs created in South Wales since 1937 would be in work if it had not been for special financial facilities are questions that cannot receive definite answers. Finance was undoubtedly an important enabling factor.

It would have been useful if special financial facilities had been provided from the early 1930's, but it must be admitted that many small firms were unwilling to make use of such facilities when they were made available by the Special Areas Organisations from 1936 onwards, and preferred to cling to their "independence." There have, indeed, been complaints of interference by the officials of the Special Areas Organisations; but these complaints would hardly be considered seriously by industrialists nowadays for they are well used to controls and to receiving advice about improving productivity, etc., and the experience of organisations such as the I.C.F.C. in this respect seems to have been quite happy. There were also complaints that the rates of interest charged by the Special Areas Organisations was too high [1] but the industrialists who have taken advantage of such special finance do not now consider that this criticism has much validity.

The special financial facilities and the other inducements of the 1930's have had to be supplemented after the war by stronger measures to "guide" enterprises into the Development Areas, notably by making it difficult to obtain building licences inside the Great Industrial Belt in England. This fact indicates

[1] *E.g. The Report of the Labour Party's Commission of Enquiry into the Distressed Areas* (1937) which says of S.A.R.A.: "The results in South Wales have so far been small, and throughout the Special Areas we have heard complaints of high interest rates, absurdly short repayment periods and other onerous conditions."

that measures to make capital available more easily to enterprises in the Depressed Areas than to those elsewhere were not of much use if the forces of localisation (the relative cost of bringing together the factors of production [1] and the relative cost of distributing the products) tend to draw potential enterprises away from such Areas. (It is true, however, that the provision by Government Authorities of stronger inducements for enterprises to go to places like South Wales after the War was to some extent due to the increased attraction of the axial industrial belt in England by then as compared with the 1930's.)[2] If, on the other hand, all the factors governing localisation suggested to potential entrepreneurs that South Wales would provide a suitable place for their factories their project might still not materialise unless capital were made available to them more readily than to entrepreneurs opting for other locations. This financial part of the Special Areas policy was brought into operation rather late, but it worked quite effectively for South Wales as shown in this paper. Decision about the ultimate advisability of providing special financial facilities to enterprises in such areas depends of course upon opinion about the wisdom of fostering industry in the relatively Depressed Areas.

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[1] Within an economy such as that of the United Kingdom imperfections in the supply of capital are clearly not very significant contributory determinants of localisation.

[2] cf. A. C. Hobson, "The Great Industrial Belt," *Economic Journal*, September, 1951, pp. 573–4.

A Regional Example of the Mercantilist Theory of Economic Policy

I.

Interest in the economic writings of the early Eighteenth Century has been greatly stimulated by the fertile suggestion of Lord Keynes [1] that behind the multifarious policy recommendations of the Mercantilists, there may be a basic approach to economic policy not unlike his own. Following this up, we find that although historians have given detailed accounts of individual policies, there have been few attempts to reconstruct the corpus of theory of economic policy upon which they were grounded.

To attempt to do this in the case of the Scottish economic writings of the early years of the Eighteenth Century is the object of this essay.

II.

The revival of interest in secular and, in particular, economic affairs after the Revolution of 1688, after a century of internal disruption and strife dominated by theological controversy, is a phenomenon well known to historians of Scotland.

From our vantage point in the Twentieth Century it is easy to see it merely as one aspect of the growing spirit of rationalism which was to be so characteristic of the Eighteenth Century, and hence, it comes as no surprise when we find one of the foremost Scottish political and economic thinkers [2] denouncing the traditional metaphysics and logic as taught at the Scottish Universities. In England too, economics had been stimulated by the rising reputation of the natural sciences

[1] *General Theory of Employment, Interest and Money* (London), 1935 : Chapter 23, Notes on Mercantilism, &c.

[2] William Seton, *The Interest of Scotland in Three Essays*, 1700, p. 69. Logic and metaphysics are denounced as " . . . fit only to subtilize their (the students') brains being the true cob-web learning of the world . . . "

and important economists had played a leading role in popularising the new scientific method.[1] But England had produced a continuous line of economic writers ever since the time of John Hales [2] with genuinely great economists like Thomas Mun appearing early in the Seventeenth Century and providing a basic corpus of theory for two or three generations. In Scotland it was quite different. The economic literature which flourished around 1700 was something new and if we examine a standard economic bibliography [3] we find scarcely any works, which have any explicit theoretical pretensions, published before 1695.

This concentration, however, was purely quantitative in nature and it would be wrong to imagine that there was in Scotland an abrupt revolution from the economic morality of the Schoolmen to sophisticated rationalism in the course of a few years. It is true that recent investigation [4] has shown that the reformation of religion in Scotland did not produce the incisive break with the past which the followers of Max Weber have been apt to suppose. Nevertheless, a study of the economic policy of Scottish governments does seem to indicate a change in its orientation round about the close of the Sixteenth Century. "It is an industrial and national as opposed to a fiscal and commercial policy and the legislation of the Seventeenth Century, corrupted as it was by the greed of councillors and Kings, in reality marks a great advance." [5] The new policy was concerned with national wealth, military potential and the level of employment and these were the criteria it applied to particular proposals rather than the sanctions of Holy Writ and custom. By the end of the century this new approach ruled supreme and although it was sometimes argued that the restrictive, stratifying institutions of the

[1] *e.g.* Sir William Petty, both at Oxford during the Commonwealth and later as a founder member of the Royal Society.

[2] John Hales, *A Discourse of the Commonweal of this Realm of England*, 1581, but probably written in 1549.

[3] W. R. Scott, *Scottish Economic Literature to* 1800 (Glasgow and Edinburgh), 1911.

[4] H. M. Robertson, *Aspects of the Rise of Economic Individualism* (Cambridge U.P.), 1935. Chapter IV, pp. 88–100.

[5] John Davidson and (Sir) Alexander Gray, *The Scottish Staple at Veere* (London), 1909, p. 67.

past should be revived, this was always as a means of securing the objectives of the new type of policy.[1]

The phenomenon, then, which it is the purpose of this essay to discuss is not a revolution in ideas, but a sudden burst of interest in and elaboration of a general approach in matters of economic policy which had gradually been gaining support for at least one hundred years, but which, hitherto, had not attracted the attention of the private, but politically-minded individuals, who write pamphlets.

III.

When we look into the economic literature of the period a clue to this curious concentration is immediately obvious in the universal feeling of Scotland's extreme poverty. " . . . poverty is the disease of this nation and the source of the many distempers and encumbrancies it laboureth under ; it ought to be the business of those who are invested with the government of this nation, to appoint a Council of Trade . . . for contriving a scheme of trade ; the rigorous and industrious prosecution whereof, may tend to the enriching of the nation."[2]

"As to the present state, 'tis agreed to by everybody that we are in a decayed condition . . . " [3]

But although the nation's poverty and backwardness was the opening gambit of practically every pamphlet, there were considerable variations in the methods by which its extent was measured. For Andrew Fletcher, the unemployment, the beggars, the shortage of food and the prevailing misery were sufficient evidence of Scotland's economic decay.[4]

[1]Hence it was often argued that apprenticeship regulations should be enforced more strictly and even extended—because the exportation of inferior goods produced by unskilled workmen was hurting Scotland's reputation and hindering her efforts to increase her foreign trade, *e.g., Some Grievances and Complaints of the Poor Commonality of Scotland* (Glasgow), 1720, pp. 67–76.

[2]'T.W.' *An Essay concerning inland and foreign, public and private trade ; together with some overtures showing how a company or national trade may be constituted in Scotland . . .* (no place, no date), p. 1.

[3]*A Discourse concerning the Union* (no date, no place), p. 2.

[4]Andrew Fletcher: *Second discourse concerning the affairs of Scotland* (in *The Political Works of Andrew Fletcher* (London), 1732), p. 124. But he points out that every state in Europe suffers from a population of "poor"—except Holland. *ibid.*

This was the line taken by most of the writers we are considering and the problem of the unemployed or poor was nearly always placed in the foreground.

" . . . through our idleness, the one half of the nation by a sensible waste and decay are eating up the other : that we have death going about our doors and streets portrayed in the visages of mankind should extort pity and quicken the spirits of all tender Christians and put the nation to examine all overtures and proposals offered for retrieving of it . . . " [1]

"The poor are so numerous and the nation is so wasted by the judgments of God upon us . . . that although we have stretched ourselves very much, yet the poor drop away through want . . . " [2]

Another writer explicitly noticed the existence of extensive disguised unemployment and wrote " . . . few of those already employed are well or fully employed . . . " [3]

There is a little doubt that if one were to search for the most frequently used criterion of the depression of the land, one would find that it was the number of the unemployed poor.

Others tried to produce a more objective picture of Scotland's condition by making more or less elaborate comparisons with England. But this measure produced equally depressing results and one author estimated that Scotland with one-third of the area and one-seventh of the population of England, had but one-fiftieth of England's wealth.[4] Another measure was the relative rates of economic development of both England and Scotland, and here the case was even worse, " . . . a complication of circumstances . . . have kept her (Scotland) declining in wealth for above 100 years past. England at the same time, has visibly increased in trade,

[1](James Armour), *A Premonitor warning ; or advice by a true lover of his country . . .* (Glasgow), 1702, p. 13.

[2]*A letter to a Member of Parliament occasioned by the growing poverty of the nation . . .* (Edinburgh), 1700, p. 7.

[3]*Several particulars of the highest concern to the Kingdom of Scotland . . .* (Edinburgh), 1700, para. 3.

[4](John Arbuthnot), *A sermon preached to the people at the Mercat Cross of Edinburgh ; on the subject of the Union,* 1706, p. 6.

wealth, people, colonies and everything that adds to the opulence and abundance of a nation." [1]

This last point should be emphasised. Not only was Scotland poor, but she was (and recognised herself to be) poorer than one of her closest neighbours. It is this sort of situation which produces a demand for an active economic policy on the part of the government, and a desire to speed up the normal mechanism of economic development so that the gap between "us" and "them" may be more rapidly closed. It is a situation which breeds a system of nationalism but not isolationism in the true sense of that word, for the *raison d'être* of the system is to alter the international balance of power in as far as that can be done by manipulating economic quantities. Thus it was in the present case of Scotland faced by a more prosperous England ; thus it had been in the case of England in the days of Thomas Mun when the comparison was with Holland ; and thus it was to be in the Germany of Friedrich List and the America of Henry Carey. Whilst Britain herself in the halcyon days of the early nineteenth century was so obviously without rivals that she could afford to be satisfied with the natural rate of economic progress and rationalised her complacency by proving that the natural rate was also the maximum rate.

Mercantilism, however, cannot thrive purely on a diet of inferiority feeling and poverty ; nor did it in Scotland. The present situation was unsatisfactory but it might be changed. Potentially Scotland was a rich country, well endowed with population, natural resources, and an advantageous geographical position all of which gave promise of wealth and prosperity in the future if their development was guided and assisted by a suitable economic policy.

[1] *An Essay against removing national prejudices against a Union with Scotland* (Edinburgh), 1706, p. 33. Although by an English author (probably Daniel Defoe) these opinions were not untypical. William Paterson, *Proposals and Reasons for constituting a Council of Trade for Scotland* (Edinburgh), 1700, p. vii, similarly concluded that Scotland had actually declined since the Union of the Crowns.

"This nation has the advantage of most of its neighbours, having a great many subjects of improvement, which if duly applied and encouraged, are sufficient to enrich it." [1]

"This nation has more advantages for industry at home and trade abroad than many of its neighbours. We have a competent number of people ; we have subject enough within ourselves to employ them ; we have all the necessaries of life and subsistance . . . " [2]

IV.

This, then was how Scotsmen with proclivities towards economic discussion saw their native land. At present poor, and overflowing [3] with unemployed resources, yet potentially as rich and prosperous as her more advanced neighbours. It is important to bear this in mind and to remember that here we have a situation quite different from that in which the exercises of classical economic theory were performed.

There was very little controversy about the general reason why the country now found itself in such a parlous position. A few people were prepared to lay the blame on the deficiencies of character of their fellow-countrymen [4] or on the vicious habits of the trading community.[5] Mostly, however, it was agreed that governmental policy was at fault. It was true that individuals could be found doing various things which

[1] *Some considerations in relation to trade . . .* (no place), 1706, p. 3. See also : *Essay at removing national prejudices . . .* p. 26. William Seton: *Some thoughts on ways and means for making this Kingdom a gainer in foreign commerce,* 1705, pp. 20, 25, 37. John Arbuthnot, *ibid.*, p. 10, who also pointed out the advantage Scotland could derive from her low cost of living.

[2] *Essay upon industry and trade, showing the necessity of the one, the conveniency and usefulness of the other, and the advantages of both . . .* (Edinburgh), 1706, p. 4. (Probably by David Black).

[3] One of the objects of economic policy was to staunch the outflow of emigrant labour to *foreign* lands, *e.g. A letter from Mr. Reason to the high and mighty Prince the Mob,* p. 7. *The Smoking Flax unquenchable : where the Union betwixt the two Kingdoms is dissected . . .* p. 10.

[4] *e.g. Letters of John Cockburn of Ormistoun to his gardner* (publ. Scot. Hist. Soc. Edinburgh), 1904, ed. James Colville, p. 18. *Letter* of 27th December, 1734.

[5] *The Circumstances of Scotland considered, with respect to the present scarcity of money . . .* (Edinburgh), 1705, p. 4.

were socially harmful (importing luxury consumption goods, for example), but that was not a sign of their personal villainy, but merely an indication of the inadequacy of government policy, which should put a stop to hurtful trade.[1]

These opinions bring us right to the heart of the Scottish Mercantilists' theory of economic policy. Why is government intervention necessary?—for once that question is answered the group loses its cohesion and each individual becomes the advocate and the antagonist of particular policies. That the individual merchant tries to maximise his profits, according to his own lights, was not denied although it was very frequently suggested that lack of knowledge prevented him from doing as well as he might.[2] But it was universally and strenuously denied (even by those who had "liberal" tendencies [3]) that there was any natural harmony between the interest of Scotland and the interest of the individual merchant.

The interest of the community as a whole was to get out of the slough of depression, and in particular to cure the unemployment problem. Translated into concrete terms this meant more jobs, enlarged industries and trades and more output in volume terms. Taken still further, it led to the doctrines that the large (in volume terms) trade is preferable to the small trade,[4] and the distant trade preferable to the near one ;[5] both doctrines which are frequently to be met in the Mercantilist writings of England as well as Scotland.

Now the assumption upon which such a dichotomy between the interests of the nation and the individual was based, was

[1]This point of view was put most clearly by John Law, *Money and Trade considered ; with a proposal for supplying the nation with money*, 1705. Refs. to (Glasgow), 1760 edition, p. 31.

[2]A down-to-earth example of this comes from the pamphlet by J(ohn) S(pruel), *An Accompt current betwixt Scotland and England . . .* 1705, where he remarks that if only the gentlemen of Orkney and the North would" . . . teach their people to make up and handle their butter more cleanly . . . " they would be able to increase sales in the South and for export, pp. 5–6.

[3]*e.g.* William Paterson, *Prosposals and Reasons . . .* p. 53 (refs. to edition printed in Saxe Bannister, *The Writings of William Paterson . . .* (London), 1859, Vol. I.)

[4]Paterson, *Proposals and Reasons . . . ibid*, p. 53, 27.

[5]T. W., *An Essay concerning inland and foreign . . . trade*, p. 6.

that there was a considerable divergence between social and private costs of production. This divergency was stated explicitly by several of the writers we are considering.[1] The true cost of any good was considered to be the value of its import content, whilst the other money payments which the enterpriser had to make for labour and for home-produced materials were merely transfers from one of the nation's pockets to another, although to the enterpriser they might be real enough. The author of the "*Essay upon industry and trade . . .*" already referred to, shows this line of thought very clearly when he is discussing the relative merits of the woollen and linen industries in Scotland and the advantages of establishing a Scottish fishing industry.

" . . . we have wool at no charge to the nation, it being our own native product, whereas flax is for the most part imported . . . " [2]

" . . . the nation in general has this advantage (over the private fisherman), that the provision for fitting out ships are all provided at home, and upon that matter, cost the nation nothing . . . " [3] The contrast between the national and the individual's interest was again clearly stated by the same author when he wrote : " . . . it is of no import to the nation in general whether one man be richer than another . . . it's the government's concern how all may be enriched and how such who by their industry endeavour to enrich it, should be encouraged." [4] Nor was this particular author a voice crying in the wilderness ; both Paterson [5] and Law [6] stated quite explicitly that a trade which was unprofitable to the individual merchant might be highly profitable to the nation if the import content of the goods in question was small.

[1] *Essay upon industry and trade showing the necessity of the one . . .* p. 4 9, 38. Paterson, *ibid.* John Law, *ibid.*, p. 22.

[2] *op. cit.*, p. 9 and also p. 4.

[3] *op. cit.*, p. 38.

[4] *ibid.*, p. 7.

[5] *ibid.* Paterson gave this example : if the cost of a last of fish is £10 of which the import content is £2, then to sell at £10 will bring zero profit to the merchant but £8 profit per last to society at large.

[6] *ibid.* " . . . A nation may gain where the merchant loses . . . as the maintenance and wages of the people employed . . . amount to."

Is this sort of argument an egregious fallacy? Most of the earlier commentators on Mercantilism have thought that it was and have attributed it to a mystical faith that bullion was the true, and only, source of national riches. It is true that practically every Mercantilist wanted to see gold and silver flowing into his country,[1] but we have *prima facie* evidence that the doctrine of the divergency of private and social costs was not necessarily dependent on any pure gold-fetish from the fact that John Law, who could hardly be said to have shown an excessive veneration for the virtues of bullion, was an explicit supporter of the former.

Indeed the phenomenon can be more satisfactorily explained without attributing to intelligent men such an improbable belief—and a belief which is contradictory to their other statements about the nature of national wealth.[2] A true cost to any group is essentially a measure of the sacrifice suffered to procure a particular good, which in turn is measured by the alternative good which might have been enjoyed had it not chosen to have the first one. Cost is merely a consequence of the fundamental scarcity of resources, and the economic theory of cost is but an elaboration of the old tag that you cannot have your cake and eat it. The foreign currency with which imports were bought, was undoubtedly scarce to Scotland and its use involved sacrifice in so far as it was not available in limitless quantities and hence had to be allocated between alternative uses. In the case of home resources, the position was quite different. Unemployed labour and virgin natural resources were available, in considerable quantities. Therefore, production could be increased in one sector without a compensating decrease elsewhere. It is true that men who were previously unemployed would now be given work, but the Scottish writers whom we are considering did not make the

[1] see Charles Wilson, "Treasure and Trade Balances . . . " *Econ. Hist. Review*, 1949, who has argued that there were many highly valid reasons for wanting a favourable balance, given the circumstances of international trade when the Mercantilists were writing. For discussion on this point, see Eli Heckscher, *Econ. Hist. Review*, 1950, 2nd Ser. III and Wilson, *Econ. Hist. Review*, 1951, 2nd Ser. IV.

[2] *e.g.* John Law, *ibid.*, pp. 110–111. "National power and wealth consists in numbers of people, and magazines of home and foreign goods."

curious assumption that a man was placed in a preferred position when you prevented him from earning an honest living : indeed, most of them were convinced that the deterioration of his quality as a workman, whilst he was unemployed, was considerable [1] and had they been strictly logical they would have counted the creation of work as a social gain which would offset the social cost of the import component of production.[2] But, it may be objected, if there is no scarcity of domestic resources and if their use involves no social cost, then *ipso facto* there can be no scarcity of foreign currency which can be bought by the export of cost-less home products. This ignores the realities of the Scottish situation and also the very important time-factor. Now, foreign currency is scarce because export industries are decayed, they will remain decayed if they are allowed to operate purely on a basis of private costs. Therefore, so far as present policies are concerned, calculation must be on the assumption of limited supplies of foreign currency. For the future there are institutional reasons to suppose that this basic scarcity will persist for certain "hard currencies" in the Baltic,[3] but at least one optimist was prepared to look forward to a time when flourishing home industries would, at least, go far to solving the problem of the scarcity of foreign currency.[4]

Before we leave this question of private and social gains and losses, it will perhaps be profitable to consider in detail one small point as an illustration of the sort of approach I have indicated. Is it possible for the nation to lose whilst individuals are gaining ?

John Law's opinion is stated clearly : "A nation may gain where a merchant loses, but whatever the merchant

[1]Paterson, *ibid.*, p. 36.

[2]When it was argued that the use of domestic raw materials did not involve a cost, they were not being entirely logical. In the case of sheep's wool, fishes and other non-wasting assets they were probably right—and it was these sorts of raw materials which they had in mind. In the case of wasting assets, (minerals, etc.,) there is a social cost of using resources which, at present, are unused, but numerically, this will be small because the sacrifice in the future must be heavily discounted.

[3]Mr. Wilson discusses this problem in a most stimulating fashion in his first article already mentioned.

[4](James Armour), *A Premonitor Warning* . . . p. 16.

gains, the nation gains equal and so much more, as the maintenance and wages of the people employed . . . amount to." [1] Yet many of the other writers were firmly convinced that there were cases where the merchants' gain was a national loss.[2] The principal of these was where the merchant carried on a profitable trade in the export of raw materials, like wool, which could be manufactured at home. Such a proposition, does not seem to be in harmony with a belief in the super-abundant supply of indigenous raw materials available at no social cost, which, interpreted strictly, leads to Law's conclusion. It becomes clear, however, that the economists we are considering (including, probably, Law himself) never held it strictly. Not all factors of production were super-abundant; in particular, there was a distinct scarcity of capital and entrepreneurship which it was the duty of the State to increase by its policy. Indeed, had there not been some scarcity somewhere, State interference with the decisions and freedom of individuals would be quite unnecessary. Because he followed the calculus of private cost, the individual businessman was liable to direct socially scarce resources (his own ability and capital) into occupations which were relatively unprofitable from the social point of view; it was this misapplication of resources which had to be stopped. And so, although in a sense Law was right—private gain always brings some social gain; the other writers were also correct in so far as a maximisation of private gain may not be a maximisation of social gain, and in the peculiar circumstances of the time was unlikely to be so.

V.

The policies recommended were consistent with the above view of the theoretical foundation of the Scottish mercantilists' writings. The importation of luxury goods diverted demand from home products, was the cause of domestic unemployment and decay [3] and should be stopped even if that meant that the

[1] *ibid.*, p. 33.

[2] *Essay upon industry and trade*, p. 6. *A Letter concerning the consequence of an incorporating Union in relation to trade*, 1706, p. 15.

[3] *Letter to a Member of Parliament occasioned by the growing poverty of the nation, from want and decay of trade . . .* (Edinburgh), 1700, p. 6.

consumer had to tolerate inferior domestic products.[1] Fears were expressed that the proposed union with England would cause the Scottish nobility and upper classes to live in London rather than in Edinburgh which would also produce a decline in effective demand for Scottish goods.[2] The case for the prohibition of the export of raw materials has already been mentioned and was, similarly, consistent with our basic hypothesis.

Recommendations of this kind are met with the utmost regularity in the literature and are well known to students of Mercantilist policy. Individual proposals were ignored or rejected,[3] but even genuinely liberal-minded men (like Paterson) were unable to dispense with them altogether.[4]

The more general argument in favour of a positive balance of trade was equally consistent. "The chief thing, in the first place we should aim at, with regard to our trade, is to bring the balance on our side." [5]

" . . . foreign trade is of such a chemical nature and virtue, that it can extract the finest metals out of the basest ; convert the worst of commodities into the best, turn a barren land into fruitfulness, and make a condemned and slighted people, a formidable and awful nation." [6]

"The ordinary mean, whereby we can flourish in wealth, is, that Balance which arises from the exchange of our natural or artificial product with other places." [7] " . . . nothing but

[1] *ibid.*, p. 8.

[2] *A Discourse concerning the Union* (no place, no date), p. 7, but, in this case, the countervailing attractions of a Union prevailed.

[3] This is true in the case of the prohibition of the export of raw materials which Paterson (*ibid.*, pp. 19–21) ignored in his discussion on tariffs and which Law opposed (*ibid.*, p. 28).

[4] *ibid.*, p. 20, where Paterson proposes that the import duties on finished goods " . . . not fit to be manufactured or meliorated in this Kingdom . . . " should be doubled.

[5] *Essay upon Industry and Trade* . . . p. 30, but this writer was not typical when he added that we " . . . should trade with no nation to disadvantage . . . " *ibid.*

[6] *An Essay concerning inland and foreign . . . trade*, p. 3.

[7] *Speech* delivered by William Seton to the Parliament of Scotland, 2nd November, 1706, p. 5. Also printed in Daniel Defoe's, *History of the Union between England and Scotland* (1786 edition), pp. 312–316.

such a regulation in our commerce with other nations as will make us gainers in the Balance of Trade, can either bring us in wealth, or keep it among us . . . "[1]

The reasons given for this concern were various and often implicit. It was useful to have a reserve of bullion " . . . when any strait comes . . . "[2] and its universal use as a unit of account added to its attractions.[3] But the Eighteenth Century's desire for an export surplus was, in essentials, analagous to the "*Beggar-my-Neighbour*" policies of the nineteen-thirties.[4] It would have a stimulus effect on the home economy in that " . . . commonly where a particular man can get a penny (by foreign trade), the nation in general gets seven or eight . . . "[5]; it was a market for the increased produce of Scottish industry. Furthermore an export surplus was the only way in which the circulating medium of the country could be increased. It is interesting to note that both of the authors who express so forcibly the necessity of a favourable balance in the process of economic expansion, were sceptical of the ability of paper credit to become an efficient substitute for bullion.[6]

One of the characteristics of the Scottish writings, however, was that they placed less emphasis on securing an export surplus as an immediate policy objective than their counterparts in England. Indeed, one is left with the feeling that the state of the foreign trade balance was rather an index of the success of other, more direct, methods of stimulation.[7]

Finally, it is perhaps worthy of mention, that none of the pamphlets that I have come across suggests that a prohibition of the export of bullion would be a solution to the problem.

[1] *The Circumstances of Scotland considered with respect to the present scarcity of money* . . . (Edinburgh), 1705, p. 23.

[2] *Some of the grievances and complaints of the poor commonality* . . . p. 27.

[3] *A Letter concerning the consequence of an incorporating Union in relation to trade*, p. 12.

[4] Joan Robinson, *Essays in the Theory of Employment* (Oxford), 1947, p. 156, *et seq.*

[5] William Paterson, *ibid.*, p. 69. This is not, however, an enunciation of a "proto-foreign-trade-multiplier."

[6] *The Circumstances of Scotland considered* . . . p. 5. William Seton, *Some thoughts on ways and means for making this Kingdom a gainer in foreign commerce* . . . 1705, pp. 63–65.

[7] *e.g. Letter to a Member of Parliament from a well-wisher of his country in relation to coin.* A broadsheet.

VI.

The major policy expedients, although they cover a wide range of topics, were essentially complementary in nature. They can be classified in very many different ways, and I propose to consider them under two main heads. Firstly, the proposals which aimed at bridging the divergence between public and private costs by distorting the latter ; and secondly, those which were concerned to create an economic atmosphere in which production following the private cost calculus would be expanded.

The import restrictions and the prohibitions of the export of raw materials were obviously important components of the first line of policy and have already been considered, but equally important in this respect were the schemes to subsidize Scottish industries.

William Paterson's "*Proposals and Reasons for constituting a Council of Trade*" was by far the most detailed and comprehensive treatment of this subject and for that reason and because his ideas were so often copied by lesser writers of the time,[1] I propose to consider this work as an example of the best thought in this particular field.

Paterson's Council of Trade was to be a small, wieldy, body composed of representatives of the nobility, barons, burghers and the foreign trading companies.[2] It was to be financed by taxes on inheritence, sales of property, manufactures and food, together with several of the smaller sources of revenue of the Crown, such as ward holdings and forfeitures ; [3] and on the basis of these revenues it was to be allowed to borrow up to £1 million sterling.[4] Part of this fund (£400,000) was to be used to compensate the losses of the stockholders of the African Company ; [5] with the rest, workhouses and public

[1]Seton, *Some thoughts on ways and means . . .* p. 18, *et. seq.* This work has every appearance of being a plagiarism of Paterson's *Proposals . . .*

[2]pp. 7–8.

[3]pp. 9–11. Value taxes of one-tenth on corn and one-fortieth on the other items.

[4]p. 11.

[5]pp. 12–13.

granaries were to be built and encouragement given to Scottish industries by granting interest free loans.[1]

The arguments in favour of industrial subsidies were most complete in the case of the fishing industry. Paterson was convinced that considerable expansion of the sales of Scottish fishery products would be possible if prices were reduced.[2] For society as a whole, such a reduction was perfectly possible because the social cost of a last of fish was small compared with the private cost. Therefore, fishermen had to be persuaded to reduce prices and to this end, Paterson was prepared to sink two or three hundred thousand pounds sterling,[3] in the expectation that when skills were redeveloped and an efficient organisation created, the industry would be able to compete, without assistance, in world markets.[4]

The subsidies would be paid out of the taxation which financed the Council, and Paterson's next task was to prove that the disincentive effect of the taxes would not outweigh the advantages of the subsidies.

In his plan it had been proposed to raise most of the revenue from a 10% tax on corn. The effect of such a tax on consumption goods would, he thought, vary according to the income of the consumer ; the rich being encouraged to consume less and the poor to work longer and harder.[5] In Scotland, where gross annual consumption exceeded gross annual production,[6] such a result was desirable when, as in this case, the proceeds of the tax were to be used to subsidize home industries. Nor could it be said that this was merely a tissue

[1]p. 15.

[2]p. 54.

[3]p. 55.

[4]The last point is not stated explicitly, but it seems to be a justifiable inference from Paterson's belief (*a*) in the natural advantages of Scotland (p. 52) ; (*b*) his emphasis of the importance of the skills and organisation which his proposals would foster (p. 61) ; (*c*) his belief that the present decay of the industry was due to the loss of the old skills during the period when the industry was dominated by State-sponsored monopolies (pp. 42–43).

[5]p. 32 : the proviso is made that the tax will have these effects only if it is moderate.

[6]p. 32 : he deduces this from the fact that " . . . the nation is upon the decaying hand . . . "

of unsubstantiated hypothesis, for the condition of Holland, the richest and yet most taxed country in the world, was a living example of the benefits which a nation could derive from taxation, properly applied.[1]

Here we have an example of the way in which the economists we are considering were prepared to upset the preference systems of individuals and intervene boldly in the working of the private-cost economy in order to ensure that individuals' actions conformed to socially desirable norms.

Another example is to be found in the insistence that the State should inspect all goods going for export and should erect and enforce official quality standards.[2] This concern sprang neither from paternalism nor obscurantism but from a knowledge that the ill-repute of Scottish goods abroad was hindering the expansion of the export trade and that it was not always in the immediate interest of individual merchants to concern themselves with this fact. As a later writer put it (and the problem was felt more acutely then) : "I do not think it is enough for a man to say, I am venturing my own stock and may do as I like, I myself, if I am wrong, must be the first sufferer ; this is true, but he will, if he miscarries, not be the only sufferer, for as much bad cloth as he makes, so much drawback comes on the country's reputation . . . " [3]

VII.

The second main group of policy recommendations were those which sought to apply a less selective stimulus to the whole economy.

In the first place, there were the schemes which were based on an increase of the supply of money either by a

[1] p. 34.

[2] *e.g. Essay upon industry and trade* . . . p. 10. *Some grievances and complaints of the poor* . . . pp. 60–76. Seton, *Some thoughts on ways and means* . . . pp. 33–34. *Letter to a Member of Parliament occasioned by the growing poverty of the nation* . . . pp. 18–19.

[3] "*A letter to the author of the "Interest of Scotland considered" containing some hints about the linen manufacturers*" (Edinburgh), 1734, p. 16.

devaluation of the metallic currency,[1] the issue of paper credit by the Treasury or the Africa Company,[2] or by the various, rival, projects for a land-bank.[3] Beyond a basic agreement that an increase in the quantity of money in circulation was necessary to stimulate production and employment,[4] there was little homogeneity in this group of writers and they were often critical of the proposals of their colleagues.[5] Nevertheless the possible difficulties in the path of such a policy were not ignored by its more penetrating advocates. To increase the supply of money might cause prices to rise if it was done to excess. Both Law and Seton agreed that, in any country, a certain, requisite, amount of money was necessary for trade and industry to flourish and that " . . . all money in a country above that sum which its people can employ, serves for nothing but to lower its own value . . . " [6] But in the case of Scotland, it was obvious, from the depression that prevailed, that this limit had not yet been reached.

Nor was it thought that credit expansion would exacerbate the country's balance of payments problems. Quite the contrary ; the increase in domestic output which the monetary policy proposed would produce, would make more goods available for export and would, thus, have a directly beneficial

[1] *e.g.* William Seton, *Some thoughts on way and means* . . . pp. 66. J(ohn) S(pruel), *An Accompt current betwixt Scotland and England* . . . p. 10. *The Circumstances of Scotland considered* . . . p. 20, but this author reserves devaluation as a policy for times of desperate emergency such as war and famine.

[2] (James Armour), *A Premonitor Warning* . . . p. 9, *et seq.* James Hodges, *Considerations and Proposals for supplying the present scarcity of money and advancing trade"* (Edinburgh), 1705.

[3] John Law, *ibid.*, p. 158, *et seq.* Hugh Chamberlain, *A Proposal by Dr. Hugh Chamberlain . . . for a bank of secure current credit to be founded upon land,* 1695. *Several particulars of the highest concern to the Kingdom of Scotland.*

[4] At its most naïve, the proposition was stated thus " . . . for no country ever enjoyed a great trade without plenty of one of them (money and credit) ; nor no country ever failed of a great trade that abounded in either . . . " *Several particulars of the highest concern in the Kingdom of Scotland* . . . " para. 6.

[5] *e.g.* John Law on Chamberlain (*ibid.*, Chapter VI, p. 147, *et seq*) and on the advocates of devaluation (*ibid.*, p. 79, *et seq*).

[6] Seton, *ibid.*, p. 62 also p. 64. See also Law : *ibid.*, pp. 168–9.

effect.[1] A line of argument such as this is not inherently untenable, but it does depend on a series of assumptions about the consumption habits of the community at large which the writers we are considering failed to make explicit.[2] But for them the problem was not of very great importance because they would obviously have had few scruples about imposing extra fiscal and physical controls on foreign trade to prevent an adverse balance from reducing the benefits of internal monetary policy.

Finally, it should be noticed that the monetary experimenters like Law were not the only ones to advocate a potentially inflationary policy. Paterson, a Conservative as far as the currency was concerned,[3] would finance the activities of his Council of Trade out of funds, borrowed on the security of certain annual revenues, and there is no evidence that he supposed that this action would cause a compensating reduction of private investment in other sectors of the economy. Seton was able to combine in the same book [4] a policy for establishing a "Judicature of Trade" very similar to Paterson's Council, and advocacy of devaluation of the currency. Shortage of circulating capital was recognised to be one of the reasons for Scotland's backwardness, and some sort of policy to produce it synthetically without waiting for the slow, natural increase of private savings, was an integral part of the agreed foundations of economic policy.

[1]James Armour, *ibid.*, p. 16. John Law, *ibid.*, pp. 198–9. But Law makes the explicit assumption that home consumption is constant. In another context he assumes that the consumption of the unemployed will increase by one-quarter when they are given work, *ibid.*, pp. 22–23.

[2]Nevertheless, it is clear that John Law was thinking along very different lines from Twentieth Century economists so far as this topic was concerned. His case against a policy of devaluation illustrates this: devaluation was opposed because its effect on the terms of trade would increase the value of imports and reduce the value of exports and thus increase balance of payments difficulties—an argument which is valid only if the demand and supply curves of internationally traded goods have very small elasticity, *ibid.*, p. 40, *et seq.*

[3]Paterson, *ibid.*, p. 93, *et seq.* Devaluation is described as a " . . . purloining trick of State . . . "

[4]Seton, *Some thoughts on ways and means . . .*

VIII.

So far we have considered purely national policy. But Mercantilism was essentially a system of policy which had its eyes fixed on the outside world. For the Scots writers, not only did the outside world provide the raw material for the coinage, it was also a market for home products. But it was a particularly insecure market for a country like Scotland which possessed no strategically important exports like the naval stores of Scandinavia. Political decree, the result of the same sort of theorising as their own, might block Scottish exports at any time and with disastrous results. Such a contingency could not be ignored, and, as in England, it led to an insistence that Scotland must have political control over its export markets. A Scot, writing in 1700 put the position very neatly. We must " . . . promote our plantations in America, with the utmost vigour : seeing the same would be a most proper place, and better than any place in Europe, for the consumpt of our manufactories . . . and, the truth is, our manufactories, without a plantation to consume them, will come to no great account ; seeing all places in Europe, either have manufactories of their own or have supplies from other places . . . "[1] When the Darien Scheme had finally been proved a failure, most of the economists who favoured this line of policy, fell back on the Union with England and the opening up of the English home and colonial markets to Scottish products which would result,[2] as an alternative to a Scottish colonial empire.

William Seton of Pitmedden was a powerful advocate of the Union [3] and in his various writings we find economic arguments playing an important rôle. In 1700 he was content with the bold assertion that as a result of a Union, Scotland's " . . . trade

[1] *Letter to a Member of Parliament occasioned by the growing poverty of the nation* . . . p. 18.

[2] Nevertheless, it would be wrong to suppose that the English Navigation Laws were able to exclude the Scottish trades completely. See Theodora Keith, *The Commerical Relations of England and Scotland*, 1603–1707 (Cambridge), 1910, p. 126, pp. 132–5. W. L. Mathieson, *Scotland and the Union* . . . (Glasgow), 1905, p. 344.

[3] And one of the Scottish Commissioners at Whitehall, who negotiated the Treaty of Union. He was also one of the Commissioners appointed for the distribution of the "*Equivalent Fund*," awarded to Scotland by the XVth Article of the Treaty.

will increase having as free a trade over the whole world, as England, which would enable it, not only to contribute more for the safety of the public ; but to improve all its barren ground, to the great satisfaction and profit of land proprietors . . . Its poor would no longer be a charge to the nation ; because they could be employed in manufactories . . . " [1]

The pamphlet of 1705 [2] scarcely discussed the question of Union, but did not ignore the necessity of securing overseas markets for Scottish goods. Seton was inclined to discourage any new attempts to settle colonies outside Europe [3] and seemed to think that by manipulating fiscal controls, Scotland would be able to secure advantageous markets in Europe.[4]

In his speech to the Estates, however, in November, 1706, the economic argument for Union was forcibly presented.[5] "The ordinary means whereby we can flourish in wealth, is, that balance which arises from the exchange of our natural and artificial product . . . : but we have no valuable branch of export, which does not interfere with the like commodity, in some more powerful neighbour nation, whose interest it is to suppress or discourage our commodity for raising the value of its own ; so that there is no demonstrable security for the vent and encouragement of any branch of our export." [6] Wherever we trade as an independent nation, our goods will be subject to discouragement " . . . *at least after the same manner as we discourage export from thence*" [7]. This is the crucial mercantilist dilemma which is bound to occur whenever the whole world practices what it preaches. Seton's solution was Union, whereby Scotland could enjoy the advantages of

[1] Seton, *The Interest of Scotland in three Essays*, p. 57. England would also gain, curiously enough by the increased flow of Scottish immigrants " . . . So that the number of people which dies by excess and debauch in and about London or the southern provinces would be supplied." *ibid.*, p. 54.

[2] Seton, *Some thoughts on ways and means for making this Kingdom a gainer in foreign commerce . . .* "

[3] *ibid.*, p. 46.

[4] *ibid.*, p. 51.

[5] It can be found most conveniently in Defoe's, *History of the Union.*

[6] Seton, *op. cit.*, p. 6 ; Defoe, *ibid.*, pp. 312–16.

[7] *ibid.*, my italics.

English markets and freedom from English discriminatory legislation " . . . by this Union we'll have access to all the advantages in commerce the English enjoy ; we'll be capable by a good government to improve our national product, for the benefit of the whole island . . . " [1]

Other writers elaborated the particular advantages Scotland would derive, such as the opening up of the West Indian and American plantations to the West Coast shipping trade.[2] The main stumbling block in the way of a Union, however, was the Scottish woollen industry. It was generally agreed that it could not compete with the English industry and yet, as we have seen, good arguments could be advanced for supporting it.[3] From the mercantilist point of view this was a serious disadvantage and although some optimists argued that after the Union, English wool masters would transfer part of their business to Scotland,[4] most advocates of the Union were content to ignore it. More emphasis was given to the importance of securing entry for Scottish linens into England,[5] and gradually the belief grew that Scotland's staple manufacturing industry was linen cloth based on home-produced flax.[6] If this could be accepted, that the industries of Scotland and England were complementary, then the obstacles in the way of Union as a substitute for a Scottish colonial policy were considerably reduced although, theoretically, colonialism would remain the preferred policy. Perhaps more than any other single factor, this belief that free trade was advantageous only between complementary economies epitomizes the theoretical naïvety and the essentially short term interests of Scottish mercantilist economics.

[1] *ibid.*, p. 11.

[2] *Scotland's interest : or the great benefit and necessity of a communication of trade with England*, 1704, p. 3.

[3] See Scott, *Records of a Scottish Cloth Manufactory at New Mills, Haddingtonshire* (Edinburgh), 1905 . . . Introduction, for an account of the legislative action taken in its support and its ultimate decline in the face of English competition.

[4] *A Letter from Mr. Reason* . . . p. 6.

[5] Seton, *The Interest of Scotland in three Essays*, p. 60.

[6] Patrick Lindsay, *The Interest of Scotland considered* (Edinburgh), 1733. Parts II and III.

IX.

Apart from the policies of credit creation of men like John Law, it will be observed that the concrete recommendations suggested were mainly piecemeal in character. This, however, did not spring from an atomized view of the economy as a whole : indeed, it was just because the writers we are considering were aware of the interactions and relationships of the various sectors that they could be content with piecemeal policies. The general interconnectedness of economic quantities would ensure that stimulation applied at one point would be transmitted to all industries and to every corner of the land. Paterson had realised this when he argued that public expenditure on workhouses and granaries would create a demand for the products of agriculture and the fisheries and would, hence, bolster up the more direct encouragement given by the Council of Trade.[1] Another author, expressed the same idea more abstractly when he wrote : "Thus you may see everything has a dependence upon another as the links of a chain. Live trade in one subject affording matter for others and these again producing subject of work for people of other employments, make a profitable and pleasant harmony in the whole body . . . "[2]

Here we have, in a simple form, the theory of "pump-priming" and on this basis the economists we are considering could reasonably concentrate their policies on individual industries in the expectation that a chain of reactions would be started which would raise the whole economy to a new level of prosperity and activity.

X.

That brings me to the end of my survey of the foundations of the Scottish economic literature of the early days of the eighteenth century. The age was severely practical ; methods had to be discovered to increase the national product [3] of the country and to this end a whole range of policies were devised. To support or attack individual policies, theories were mustered

[1]Paterson, *ibid.*, pp. 55–57.

[2]*A Letter from Mr. Reason . . .* p. 8.

[3]William Seton used this term in his Speech on November, 1706, *ibid.*, p. 11.

but essentially theory played a secondary rôle and was not formulated abstractly for its own sake. The test of the theory, then, must be the policies which it produced and we must ask ourselves whether they were likely to have the effect desired of them. The experience of the process of economic expansion which we now possess, has given us an insight into its complexities rather than an understanding of its operation, and he would be a bold man who would presume to stand in judgment over his predecessors' opinions in this matter. What we can say is that the writers of the period applied themselves to an eminently reasonable problem and produced solutions which, given the environment in which they lived, were not only consistent but have not yet been demonstrated to be the product of egregious fallacy. The Scottish conjuncture at the beginning of the eighteenth century was such that this basic aim of mercantilist policy and the consistency with which it was pursued are more apparent than in other countries at other times, and this gives the Scottish discussion a significance which it would not otherwise deserve. It gives us a clear insight into what the Mercantilists in general were trying to achieve which is more satisfactory than the traditional notions that they were bemused by the will-o'-the-wisp of gold and that they were the spokesmen of purely selfish sectional interests.

This is not to say that none of their policies were mistaken.[1] Indeed, it would be very surprising if all their suggestions were, in fact, appropriate for the end they had in view. There must have been error, but it is not discoverable by purely tautological processes and the depressing fact must be faced that after 250 years of progress, the modern theory of economic policy finds it very difficult to lay its finger on a policy recommendation and say, this will not have the effect expected of it.

J. M. Low

University of Manchester.

[1]Prof. Jacob Viner complains that the rehabilitators of the Mercantilists fall into the error of supposing that no age is capable of "doctrinal error" except their own. See *Studies in the Theory of International Trade*, p. 110.

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NOTE.

In the article "World Production, Prices and Trade, 1870–1960," published in *The Manchester School*, May, 1952, use was made of certain annual series of world trade in primary products and manufactured products, which were attributed to the United Nations. The United Nations have asked us to state that these series are still in process of revision, and were not authorised for publication. The final series will be published in due course by the United Nations, with appropriate information as to the scope and reliability of the data, and the methods of computation.

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The Theory of Forward Exchange and Recent Practice

This paper falls into four sections. In the first, the traditional theory of forward exchange with full scale *arbitrage* is restated, with the emphasis on some points which have not, perhaps, received enough attention. In the second, a model case is examined, with no professional interest *arbitrage* and no currency speculation. The third section, which is by far the longest, is devoted to a detailed examination of speculation and its effects on forward sterling since the reopening of the foreign exchange market in December 1951. In the fourth and final section consideration is given to the practical implications of the earlier discussion for the balance of payments.

I

The theory of forward exchange was first expounded clearly by Keynes.[1] It rests on an exceedingly simple proposition. Banking funds available for short-term investment—say three months—will be placed in that centre—at home or abroad—which will yield the greatest return. The choice of centre will depend on four factors : on the one hand (1) the short-term interest which could be obtained if funds were invested at home ; on the other (2) the short-term interest abroad which could be obtained if the funds were exported ; (3) the spot exchange rate at which they have to be converted for transfer ; and (4) the three months forward rate ruling currently at which they can be repatriated without speculating on the movement of the spot rate in the interval before the actual repatriation takes place. If the gain (loss) on the "swap"—*i.e.*, the buying of a currency spot and its simultaneous sale forward—exceeds (falls short of) the loss (gain) from the lower (higher) interest abroad the funds will be transferred to the foreign centre.

[1]See *A Tract on Monetary Reform*. London : Macmillan & Co., 1923, pp. 115-39.

This proposition can be made more specific. Taking the foreign centre to be New York and using the notation—

K = short-term capital ;

I_B = short-term interest in Britain *per* three months ;

I_A = short-term interest in the United States of America *per* three months ;

E_s = sterling-dollar spot exchange rate, quoted (in accordance with the British practice) in numbers of dollars required to purchase one pound ;

E_f = sterling-dollar rate three months forward, quoted as for the spot rate ;

the funds will be transferred to New York so long as

$$K.E_s.(1+I_A) \div E_f > K.(1+I_B).$$

Clearly, so long as this inequality persists *arbitrageurs* will obtain a profit by a temporary transfer of funds from London to New York by means of purchasing dollars spot and selling them forward. If the inequality sign is reversed there will be a profit to be collected from *arbitrage* in the opposite direction. It follows that, provided *arbitrage* funds do not run out, the two sides will be pushed towards equality by the actions of *arbitrageurs*, and that the relationship between interest rates on the one hand, and spot and forward rates on the other, should very nearly obey the condition:—

$$K.E_s.(1 + I_A) \div E_f = K.(1 + I_B), \text{ or}$$
$$(E_s - E_f) \div E_f = (I_B - I_A) \div (1 + I_A) \ldots\ldots\ldots\ldots (1).$$

How does this condition compare with the usual formulation—to be referred to subsequently as the verbal formulation—which states that the percentage discount (premium) of the forward relative to the spot exchange rate must equal the percentage excess (short-fall) of the short-term interest in London relative to that in New York, or, in other words, that the percentage gain (loss) on the swap must equal the percentage interest differential between the two centres ? It is obvious that when $I_A = 0$ the condition expressed by (1) is identical with the verbal formulation. The latter, moreover, can be said to be a very good approximation of (1) when I_A is so small that it can be neglected. In the vast

majority of cases this holds true, but the verbal formulation cannot be said to be fully general insofar as it does not fit those cases—rare, but not outside the field of experience—where the interest rate is high enough to matter.[1] This difficulty is associated with an ambiguity familiar to economists when they leave the realm of infinitesimals. The percentage discount or premium on forward sterling is not a unique magnitude unless the spot and forward exchange rates stand close to each other, for, if they do not, this percentage will be different according as it is expressed as a percentage of the spot or the forward rate. In (1) it is expressed as a percentage of the forward rate ; expressing it as a percentage of the spot rate, the same condition now reads :

$$(E_f - E_s) \div E_s = (I_A - I_B) \div (1 + I_B),$$

and the verbal formulation is consistent with it if I_B (and not, as previously, I_A) is small.

When more than two monetary centres are involved the question arises whether the above relationship between spot and forward exchange rates would yield a pattern of cross forward rates (*i.e.*, forward rates between pairs of currencies through some third currency) consistent (identical) with direct forward rates. It has always been taken for granted that it would, *even if the various centres followed independent interest rate policies*. Yet it is by no means self-evident (indeed, as shown in footnote 1, p. 91, it does not follow from the usual verbal formulation of the spot-forward relationship) and it appears worth demonstrating.

Consider the case of three monetary centres : London, New York and Paris. To begin with, triangular arbitrage " in

[1] A very pronounced case of high interest rates was that of Germany in the great inflation of the twenties. Keynes (*op. cit.* p. 120) attributed to the fantastic interest rates prevailing in Germany at that time the enormous discount on forward marks. In fact, it is doubtful whether there was any rhyme or reason in the crazy movements of German prices and exchange rates of that period. (*Cf.* P. Einzig, *The Theory of Forward Exchange*. London : Macmillan & Co., 1937, p. 291). But, even so, it would be important to operate with the general case, if only because it would be necessary to know what exact relationship to look for in testing Keynes's suggestion.

space "[1] in the spot market will secure consistent cross spot rates. Using the same notation as before, *plus*

I_F = short-term interest in France *per* three months;

E'_s = sterling-franc spot exchange rate, quoted on the British principle, *i.e.*, with the franc as *numéraire*;

E'_f = sterling-franc forward exchange rate, with the same *numéraire*;

E'' = dollar-franc exchange rate (spot with the subscript s, and forward with the subscript f) with the franc again as *numéraire*;

the condition for the consistency of cross spot rates is

$$E'_s = E_s.E''_s \quad \ldots\ldots\ldots\ldots\ldots\ldots (2).$$

From (1) it follows that

$$E_s = E_f.(1 + I_B) \div (1 + I_A),$$

and by the same reasoning it is obvious that

$$E'_s = E'_f.(1 + I_B) \div (1 + I_F), \text{ and}$$
$$E''_s = E''_f.(1 + I_A) \div (1 + I_F).$$

Substituting in (2) from the last three equations we obtain

$$E'_f = E_f.E''_f \quad \ldots\ldots\ldots\ldots\ldots\ldots (3).$$

But this is precisely the condition for a consistent pattern of cross forward rates, and *it will hold irrespective of what the interest rates in the various centres are*, since these cancel out and do not appear in (3).

This result explains how Keynes could claim that a Central Bank policy of intervention in the forward exchange market could provide an extra degree of freedom for the domestic interest rate by offsetting interest rate differentials between major centres.[2] Had the cross forward rates emerging from such a policy not been consistent, triangular *arbitrage* in forward rates would force them towards consistency, and, in

[1] Triangular arbitrage refers to arbitrage transactions involving three currencies. For instance: buying francs with sterling, then dollars with the francs so obtained, and finally buying sterling with these dollars to close the triangle. It is arbitrage "in space" because it involves different financial centres. If the deals mature immediately the arbitrage is in spot rates; if they mature at some future date it is arbitrage in forward rates.

[2] See *A Treatise on Money*. London: Macmillan & Co., 1930, Vol. II, pp. 319-31.

doing so, destroy the independent interest rate policy by making the forward rates diverge from their "interest parities." [1]

Another consequence flows from the result established in (3). If there were effective interest *arbitrage* between, say, London and New York, and Paris and New York, so that the sterling-dollar forward rate and the dollar-franc forward rate stood in relation to their respective spot rates in accordance with their interest parities, the sterling-franc forward rate would also stand in the same relation to the sterling-franc spot rate, by virtue of triangular *arbitrage* in space, even if there were no interest *arbitrage* directly between London and Paris. Situations, by no means improbable, where this might occur can be envisaged without difficulty. In judging, therefore, empirically the contribution of interest *arbitrage* in bringing forward rates in line with their interest parities it would be a mistake to examine any case in its bilateral aspects only—which amounts to saying that any reliable empirical judgment on this problem is very nearly impossible.[2]

[1] This term is employed by Dr. Einzig (*op. cit.*) and is used here to indicate the relationship represented by (1). If (1) is expressed in accordance with the verbal formulation of the interest parity relationship between spot and forward rates, *i.e.*, if in the denominator of the right-hand side of (1) $I_A = 0$, then we have

$$E_s = E_f.(I_B - I_A + 1),$$

and by similar reasoning we obtain

$$E'_s = E'_f.(I_B - I_F + 1), \text{ and}$$
$$E''_s = E''_f.(I_A - I_F + 1).$$

Substituting from these three equations in (2) we obtain

$$E'_f = E_f.E''_f + E_f.E''_f.(I_A - I_F)\ (I_B - I_A) \div (I_B - I_F + 1),$$

which is only consistent with (3) if either $I_A = I_F$ or $I_B = I_A$. In other words, starting from the verbal formulation of interest parity the conclusion emerges that a fully independent interest rate policy is not possible. The extent, however, to which the verbal formulation could be misleading in practice should not be exaggerated, for, the product of $(I_A - I_F)$ and $(I_B - I_A)$ cannot be significantly large in any but very exceptional cases.

[2] In fact no published empirical study has set itself this problem, though the degree of correlation between divergences of forward rates from their interest parities and the volume of short-term capital movements has been examined by C. P. Kindleberger, "Speculation and Forward Exchange," *Journal of Political Economy*, Vol. XLVII, 1939, pp. 163-81; and A. I. Bloomfield, *Capital Imports and the American Balance of Payments* 1934-39, Chicago: The University of Chicago Press, 1950, pp. 61-63.

II

All this is applicable to a world where liquid capital can move about in search of the most profitable employment and where currencies are convertible. This is not the world we live in at present, so it is necessary to see how things work out when capital movements, and, hence, professional interest *arbitrage,* are prohibited.

The current regulations governing forward exchange operations [1] limit considerably the shift of funds from London to foreign centres for *arbitrage* purposes. Funds domiciled in countries with no exchange control—chiefly the United States —could come to London without any restrictions on their subsequent withdrawal, but they would be incurring a loss if they came while forward sterling stood at a heavy discount in relation to the dollar. Assuming that no short-term funds can flow in either direction, the link between spot and forward rates provided by professional interest *arbitrage* becomes inoperative. Nevertheless the two rates would not be completely divorced. There is a substitute link provided by the inducement which the existence of large discrepancies between spot and forward rates offers to importers and exporters to change the centre of financing their trade.[2]

The bulk of foreign trade is financed by means of (documentary) credits and bills. The former is the more important, let us, therefore, consider it with reference to an American importer of British goods. His contract would stipulate whether payment is to be made in sterling or dollars. Assuming that it stipulates sterling, the American importer will ask his bank to open a sterling credit in favour of the British exporter, but, depending on the terms of the contract, it will be either a "sight credit", *i.e.* one which entitles the exporter to

[1] See P. Einzig, "Forward Exchange Then and Now," *The Banker*, February, 1952, pp. 83-87; and also pp. 69-70 of the same issue.

[2] This has not received anything like the attention it deserves. Dr. Einzig devotes to it about half-a-dozen lines in the article in *The Banker* (*op. cit.*, p. 85); and some pages in the pre-war book (*op. cit.*, pp. 174-75, 188-89, 217-18), which, however, refer to a different institutional setting, with the emphasis, inevitably, designed to fit that setting rather than the post-war one. All subsequent references to Dr. Einzig are to the book and not to the article.

immediate payment from the London correspondent of the American importer's bank on presentation of evidence (" documents "—and hence documentary credits) that the goods have been shipped, or an " acceptance credit," which entitles the exporter to payment only a stipulated period after the presentation of the documents. Now, a sight credit implies a cash payment and, generally speaking, the seller—the British exporter—is prepared to offer a " cash discount " to the buyer—the American importer—for such a payment, the size of the discount depending on the short-term interests ruling in London. This means, however, that the American importer has to find funds to finance his imports over the period that would have been covered by the acceptance credit, had such a credit been used. He might borrow from his bank at the appropriate interest rates ruling in New York, or he might make use of his own liquid funds if, as it often happens, they are considerable, thereby foregoing, however, the interest which he could have obtained by investing them. If spot and forward exchange rates were at par the choice between a sight and an acceptance credit would depend only on whether the short-term interest in London (which determines the cash discount) exceeded or fell short of the short-term interest in New York (which determines the cost of borrowing there, or the loss from foregone interest). But when spot and forward rates differ, this difference enters into consideration, for the sterling for a sight credit has to be remitted at once, *i.e.* purchased spot, whereas that for an acceptance credit has got to be remitted (if it is agreed between the American bank and its London correspondent) only on the maturity of the acceptance, *i.e.* can be purchased forward with maturity to match. The forward margin, therefore enters in the calculation of the dollar cost of the American trader's imports. In fact the choice between a sight and an acceptance credit depends once more on the balancing between the gain (loss) from interest differentials in the two centres and the loss (gain) from the difference between spot and forward rates. It follows that there will be a shift from sight to acceptance credits or *vice-versa* until the relationship indicated by equation (1) is

established, because if, for example, the discount on forward sterling on New York exceeds that which is justified by interest parity, acceptance credits will be substituted for sight credits and, therefore, demand for forward sterling will be substituted for demand for spot sterling, thereby narrowing the forward discount by causing an appreciation of the former and a depreciation of the latter.

In the case of American exports to Britain the position is the symmetrical reverse of that of American imports from Britain which was just examined. Taking again forward sterling at a greater discount than that justified by interest parity, sight credits will be substituted for acceptances in payments for British imports, hence immediate remittances from London to New York will expand and deferred remittances contract, thereby increasing the supply of spot sterling (demand for spot dollars) whilst diminishing that of forward sterling, with a consequent narrowing of the forward discount until it conforms to interest parity.

Mutatis mutandis the same argument, leading to the same conclusions, applies to trade financed by bills of exchange or any other method, for the general principle is the same in all cases : trade can be financed in either the importer's or the exporter's country[1]; this brings into consideration the respective short-term interest rates. If it is financed in the importer's country the remittance can be deferred until the credit matures, whereas if it is financed in the exporter's country the remittance must be immediate ; this brings into consideration the respective rates for forward and spot exchange. The shifting of centre for financing trade will stop only when there is no net advantage to be gained thereby, *i.e.* when the forward margin reflects exactly the short-term interest parity.

[1]Financing in London for trade to which the United Kingdom was not a party was also possible until it was banned at the end of February, 1952. This triangular arrangement provided a third choice of centre for financing trade, thereby reinforcing the effects of a change of centre on the relationship between spot and forward rates. Acceptances exceeding 90 days were also banned at the same time. For the significance of these bans see *The Journal of the Institute of Bankers*, April, 1952, pp. 162-64.

This is the logic of the case. It would be wrong to conclude, however, that in practice the relationship between spot and forward rates will be no different from that under professional interest *arbitrage*. In the first place, interest rates at which traders can borrow and on which they base their cash discounts are not uniform. This makes for some haziness in the concept of interest parity. True, even under professional interest *arbitrage* there is not a unique interest rate, but a whole range, which is relevant[1], but the difficulty thereby introduced is greater in the case of traders. Secondly, traders have to pay bank charges, acceptance commissions, stamp duties etc., of which professional *arbitrageurs* were free, but which must now enter into the calculations before the balance of advantage is struck. Thirdly, under professional *arbitrage* flexibility and responsiveness to disparities from interest parity is very high, a return of anything above half of 1% *per annum* being sufficient to induce a shifting of funds from one centre to another[2]. By comparison the responsiveness of traders is rather slow ; but not as slow as one might think, for, in this respect, the trader acts on the advice of his bank whose job it is to keep an eye on these things. The bank, however, does not always have all the pieces of the puzzle. It knows the sum that its client wants to remit, it knows the spot and forward rates currently ruling, it knows the interest it would charge its client as well as the bank charges that he will have to pay ; it may not know, however, the cash discount that he is offered by the seller, and this will prevent it from working out to a very fine degree the balance of advantage to its client between financing his trade at home or abroad. As to the trader, he will be the more alert in this respect the smaller the gross profit margin he operates on, because then the greater the increase of this margin will be from any given gain (expressed as a percentage of turnover) to be obtained from changing the centre of financing his trade. Finally, the volume of such changing that can take place in any one period is limited by the amount and type of trade contracts being concluded in

[1] *Cf.* P. Einzig, *op. cit.*, chap. XVIII.

[2] *Ibid.*, p. 172.

that period, which may be, not infrequently, insufficient to eliminate discrepancies from interest parity. Here again the difference from the position under professional interest *arbitrage* is only one of degree, for the funds available for such *arbitrage* were not always adequate to bring the forward discount close to the interest parity.

All these qualifications lead to the conclusion that the relationship between spot and forward rates becomes somewhat blurred when professional interest *arbitrage* does not operate. Nevertheless, even in its absence, the forward margins should not diverge greatly from the corresponding range of interest parities unless there are some persistent obstructionist forces in operation—chiefly speculation, which will be discussed in the next section. In any case, it is not a practicable proposition for the authorities to prevent professional interest *arbitrage* at all times. Banks must be allowed to hold working balances in foreign centres if their business efficiency is not to be greatly impaired. Administrative control can place a ceiling on the volume of such balances, but so long as the banks operate below this ceiling they have some scope for shifting funds for interest *arbitrage*.

III

The main factor preventing, for more than the short-run, the convergence of forward margins to their interest parities is some very elastic demand for (or, if you are looking at it from the point of view of the other currency, supply of) a currency for forward delivery, the range of high elasticity acting as a barrier, inasmuch as a narrowing of, say, the forward discount for sterling with respect to the dollar below a certain point would bring forth a very large demand for dollars, thereby making it very difficult for the forward discount to converge any further towards interest parity. Conversely, of course, a widening of the forward sterling discount beyond this point would bring forth a very large demand for forward sterling, the elastic range, placing in this case, a floor to the depreciation of forward as compared with spot sterling. The present section is devoted to a discussion of

factors which could overshadow in this way the influence of changes of centre for financing trade and of such professional interest arbitrage as has been possible. The institutional setting for this discussion is that which has prevailed since the introduction of a new policy in the foreign exchange field at the end of 1951 when forward sterling was unpegged; the empirical part is based on the experience of 1952.

Intervention by the authorities in the forward market would be an obvious source of very elastic demand for or supply of forward sterling, had the authorities set themselves the task of preventing the depreciation of forward sterling below, or its appreciation above, a certain range. In fact, however, there is no evidence of overt official intervention in the forward exchange market having taken place. Those who are on the look-out for the slightest sign of it have not been able to find any which would enable them to venture as much as a guess that the authorities had been engaged in some activity in support of forward sterling[1]. Therefore, although all official influence cannot be ruled out because there are various indirect or passive ways in which the authorities could exercise it in the forward market, its role could not have been more than a minor one, if any.

In contrast, speculation has had a considerable influence and deserves to be examined at some length.

Two types of speculation can be distinguished: (*i*) outright speculation, and (*ii*) trader-speculation. Outright speculation consists entirely of capital transactions—namely, the forward sale or purchase of foreign exchange unassociated with claims or obligations arising from current trading. This is not open to British residents who cannot purchase dollars for any

[1]The nearest thing to a guess that has been ventured is the following statement by "Lombard" (*Financial Times*, 20th June, 1952) when the forward sterling discount on New York stood at 3 per cent. *per annum*: ". . . the point was raised yesterday as to what level the British authorities might exercise the right they have retained of intervening in the forward market." On 7th June, 1952, *The Economist* (p. 696) carried the following statement about the forward market: ". . . fluctuation of rates in this market have not been subject to official limits—though official intervention may have intruded at times." This is not a guess, however, but an acknowledgment that the possibility of official intervention cannot be ruled out.

bona fide trading purposes licenced by the exchange control ; and who have to surrender any dollars accruing from exports to the Bank of England. It is, however, open to dollar area residents who may hold " American Account " (*i.e.* convertible) sterling, and are free to add to or subtract from their holdings of it[1]. Trader-speculation, on the other hand, arises from the choice which is open to all merchants between covering and leaving open the exchange risk with respect to foreign currencies accruing to them from contracted exports, or due to be paid by them for contracted imports. A merchant is speculating if he leaves the exchange uncovered ; he is not speculating if he covers it by a forward deal[2]. It follows from this definition that traders can speculate in one direction only, unless they engage in both exports and imports. A sterling area trader who has contracted to pay dollars and a dollar area trader with a contract to receive sterling are sterling " bulls " if they do not cover, but non-speculators if they do. Conversely a dollar area trader who has to pay sterling and a sterling area trader due to receive dollars are sterling " bears "

[1]For the most informative guides to the great variety of current sterling see chart on p. 141 of the *Twenty-Second Annual Report*, 1951-52, of the Bank for International Settlements, or a similar, but not identical, chart with explanatory notes in Mr. H. E. Evitt's *Exchange and Trade Control in Theory and Practice*, London : Sir Isaac Pitman & Sons Ltd., third ed., 1952, pp. 193-96 ; for changes since these charts were prepared see the consolidating Treasury Order, *No.* 1515, *Exchange Control* (*Payments*) *Order*, 1952.

[2]If one looks more closely at this definition some difficulties arise. For some traders there is no possible arrangement which can relieve them of the need to " take a view " of exchange rate prospects, *i.e.*, they cannot but engage in some degree of currency speculation. (*Cf.* P. Einzig, *op. cit.*, pp. 108-12). For, covering the exchange risk in a trade transaction by means of a forward deal means simply the fixing of the value in domestic currency of receipts or payments due in a foreign currency at some future date, which does not imply the elimination of exchange risks to all traders. Nevertheless, the statement in the text is sufficiently near the truth to be allowed to stand. Exporters whose costs are fixed in the domestic currency, and importers of goods whose substitutes are largely home-produced or whose prices are rather sticky for other reasons, as well as importers of goods which can be hedged in commodity exchanges at home, can largely eliminate exchange risks by forward covering (though the uncertainty for the economy as a whole is a different matter). The residual field of trade, which cannot benefit from forward covering for the purpose of diminishing the exchange risk, is not likely to be large.

if they do not cover, but non-speculators if they do. Needless to say that even if outright speculation could be eliminated by exchange control, trader-speculation cannot be effectively restricted if foreign trade is not taken out of private hands.

Apart from the limitations on professional interest *arbitrage* and the impossibility of outright speculation by British residents, the distinctive features of the situation in which exchange speculation has had to operate in 1952 as compared with earlier periods was (1) that spot sterling was pegged, so that the situation differed radically from that of periods of floating exchanges ; but (2) that the peg allowed a margin for fluctuation of the spot rate, thereby differing from the gold standard (when exchanges could fluctuate only within the much narrower gold points) ; and (3) that unlike (at any rate, the heyday of) the gold standard there was no absolute confidence that the peg would not be lowered. This combination of circumstances has had some interesting consequences. They are best examined by comparing the position under a fully pegged spot rate (one, that is to say, with no range for any fluctuation) with that under a floating spot rate, and introducing subsequently some qualifications to take account of a partially pegged spot rate, which can be regarded, if you like, as a combination of the other two. It will be assumed—realistically as far as the relation with the dollar in 1952 was concerned—that an upward revaluation of sterling was so improbable that it did not enter the speculators' calculations, and that, therefore, the only issue was between the maintenance of the peg at its initial level and extensive devaluation through the lowering of the peg or its complete withdrawal. It follows that, if speculation were predominant in the forward market, forward sterling would be at a discount even though interest parity might dictate otherwise.

In these circumstances, speculation under a pegged spot rate would differ, in the first place, from that under a floating spot rate in being based on much longer expectations. That is not to say that the speculator who tries to " beat the gun " by buying today and selling tomorrow, or *vice-versa*, is

completely eliminated, but that he is not such a dominant figure. For, with the spot rate pegged, there is a more distant point which stands out above the others and serves as a focus for the speculative expectations of each individual: the date of maturity of his forward deal. The reason for the pre-eminence of this date is that the maximum gain which the sterling bull can obtain if he succeeds, and the maximum loss which the bear can suffer if he fails, is uniquely fixed, and fixed only with respect to that date. This should not be difficult to see. The bull who buys sterling forward at a discount can hold an "open position" until his forward purchase matures and then sell spot, whilst the bear who sells sterling forward and holds an open position up to the maturity of his deal has to purchase sterling at the spot rate to cancel his obligation to deliver which has matured, with the result that, in the event of the peg having been maintained at its initial level, the bull makes a gain and the bear incurs a loss equal to the forward sterling discounts ruling when they concluded their respective forward deals. In the expectations of the bulls this is the maximum possible gain, and in the expectations of the bears the maximum possible loss, for, by the assumption of the previous paragraph, an appreciation of sterling beyond the existing peg is ruled out. These maxima can only be realised if speculative positions are kept open right up to their maturity, for closing them earlier means concluding forward deals (opposite to, and with maturity to coincide with that of, the initial ones) at rates for sterling short of the highest possible, since, by the assumption, again, of the previous paragraph, sterling of longer than immediate maturity would stand at a discount. The forward discount, then, at which a speculative deal is made, measures the maximum prospective gain to the bull and loss to the bear; these maxima, therefore, are strictly calculable in advance and are free of any degree of uncertainty. This is a good reason for speculators' expectations being focused on the position at the maturity of

their forward deals. Moreover, when the question is a clear-cut one—whether or not the peg on spot sterling is going to be lowered—rather than more detailed and complicated—what level is the pound going to be at ?—as it has to be when there is no peg, it is easier to form longer-term expectations ; but if, this notwithstanding, one does not want to look very far ahead, one could concentrate on shorter maturities, thereby retaining the advantage of the calculability of certain consequences with respect to the date of maturity, without this date being too far off. What all this amounts to is not that speculators, when they operate under a pegged spot rate, commit themselves to hold an open speculative position right up to the maturity of their forward deals—a good few of them would not be prepared to speculate if they had to make such a commitment—but that, whilst they might avail themselves of the opportunity either to revise their expectations or to take their profits by closing their speculative positions shortly after they have opened them, they do not embark on their initial transactions with the express intention of reversing them shortly afterwards. As to trader-speculators—so far the argument referred to outright speculators—they have always got to operate with long expectations and have to focus them on the dates at which claims or liabilities arising from trade contracts mature.

The next difference is linked with the first. Under a pegged spot rate the bulk of the speculators differ from each other only with respect to their subjective marginal valuations (related to the magnitude of their speculative commitments) of the risk involved in backing (engaging in bull speculation) or going against (engaging in bear speculation) the existing peg for spot sterling to any given extent. With forward sterling at a discount, the marginal risk valuation of the sterling bear is the additional loss he is prepared to incur, if his speculation fails (*i.e.*, if sterling is not devalued), in order to obtain, if it succeeds (*i.e.*, if sterling is devalued), the additional gain from

a marginal extension of his " short " position in sterling ;[1] and the marginal risk valuation of the sterling bull is the additional gain that he wants to make if his speculation succeeds (*i.e.*, if sterling is not devalued) to induce him to run the risk of additional loss, if his speculation fails (*i.e.*, if sterling is devalued) from a marginal extension of his " long " position in sterling. Therefore, if the forward discount exceeds the marginal risk valuation of a sterling bull he will extend his long position until they become equal ; and if it exceeds the marginal risk valuation of a sterling bear he will extend his short position until they, too, become equal.[2] It follows that, given the volume and distribution of speculative positions at the initial point, there is a determinate relationship between speculative demand for and supply of sterling, on the one hand, and the forward discount on the other.[3] For a reason to be discussed in the next paragraph, this is likely to have a range of high elasticity ; but even if it were rather inelastic, the same demand or supply

[1]This terminology is normally applied to outright speculators. Thus, they are said to have a short position in sterling if they have contracted to deliver, at some future date, more sterling than they have contracted to acquire in the interval. In the converse case they are said to have a long position in sterling. But the terminology has been extended to trader-speculators as well. Thus a trader-speculator is said to have : a short position in sterling if he is a dollar area resident with uncovered obligations to pay sterling ; a long position in dollars (short in sterling) if he is a sterling area resident due to receive dollars which he leaves uncovered ; a short position in dollars (long in sterling) if he is a sterling area resident with uncovered obligations to pay dollars ; and a long position in sterling if he is a dollar area resident due to receive sterling which he leaves uncovered.

[2]It is not, perhaps, very realistic to speak of marginal extensions of speculative positions in the case of trader-speculators. They might either cover the whole of their foreign currency claims/obligations or not cover any ; but even if they indulge in marginal adjustments these are subject to strict limits : a British exporter, for instance, can go long in dollars only up to the amount that he is due to receive on his exports, no matter how much his marginal risk valuation of going against the sterling peg exceeds the discount on forward sterling. It is, nevertheless, convenient to retain the terminology of the text, while making allowances, mentally, for the difficulty indicated here.

[3]In the special case of absolute confidence in the maintenance of the spot peg, as, for instance, when the gold standard was supreme, marginal risk valuations would be zero so that the smallest forward discount would create a flood of bulls, whilst eliminating all bears, thereby preventing, in practice, the emergence of any discount. *Cf.* C. P. Kindleberger, *International Short-Term Capital Movements*, New York : Columbia University Press, 1937, pp. 195-98.

when related to the forward rate instead of the forward discount, would appear as fairly elastic, for the simple reason that the forward discount is, normally, only a small proportion of the spot rate, so that a large percentage change in the former would imply no more than a small percentage change of the latter. Contrast to this the position under a floating spot rate. There is no presumption in that case that the speculative demand for or supply of sterling, related to the forward rate, will be elastic. For, when there is no peg for the spot rate, speculators have no single value of the exchange rate to back or oppose, no common point of departure ; they have, instead, to form an individual judgment about the rates which they expect to rule on the future dates, or series of dates, appropriate to the length of the expectations they operate on.[1] There is no reason why their judgments should not differ widely from each other, and, if they do, the speculative demand for or supply of sterling will be highly inelastic. On the whole, the presumption that under a pegged spot rate speculative demand and supply elasticities will be higher than under a floating spot rate seems fairly strong already.

But there is a further reason in support of this contention. It has been mentioned already that, unlike the position under a floating spot rate when many complicated choices face the speculators, under a pegged spot rate the alternatives are exceedingly simple. The speculators have got to make up their minds on the straightforward question, whether or not the peg will be lowered, whilst the maximum gains for the sterling bulls if they succeed and the maximum costs for the sterling bears if they fail, is strictly calculable in advance from the forward discount at which the forward deals are concluded. But the simpler the alternatives, the more people will have

[1]The usual procedure in theoretical discussions of forward trading is to describe expectations as uniquely dated. [*Cf.* N. Kaldor, " Speculation and Economic Stability," *Review of Economic Studies*, Vol. VII (1939-40), section I, pp. 3-8 ; G. Blau, " Some Aspects of the Theory of Futures Trading," *Review of Economic Studies*, Vols. XI-XII (1943-45), pp. 1-30]. As a general rule this is not valid empirically, but when it comes to a pegged spot price there is a presumption that, for each individual separately, though not in the aggregate, it is valid, for the reasons given in the text.

convictions about them; and the more calculable their consequences, the less the inhibiting effect of uncertainty. Hence the larger the number of potential speculators and, therefore, the more elastic the speculative demand or supply.[1]

These elastic schedules will be subject to shifts—sometimes considerable shifts—in accordance with changes in speculative sentiment. But, so long as speculative sentiment remains fairly constant, they should impart a considerable degree of stability to the forward rate, in spite of any day-to-day instability in the balance between commercial demand for and supply of forward exchange.

Is this borne out by the experience of 1952? An answer to this question meets with a great many difficulties. In the first place, it is notoriously difficult to interpret the day-to-day movements of a highly volatile time series such as that of forward rate quotations. Secondly, the stability of a series is not an absolute concept; it makes sense only in relation to some other series which is both comparable and—ideally—independent. But pre-war series, though independent, are not comparable, because of differences in the institutional and psychological factors, while the series of spot rate quotations in 1952, though reasonably comparable, is not independent, for there is a high degree of positive correlation between its movements and those of the forward series. Thirdly, the spot rate in 1952 was only partially pegged, whereas the reasoning which has led to the conclusion that there should be a fair amount of stability in the forward series was based on the assumption that it was fully pegged. As, however, the range of possible fluctuation of spot sterling on New York was small —\$2.78—\$2.82—and the range of actual fluctuation still smaller—\$2.78—\$2.81$\frac{3}{8}$—with the bulk of quotations clustered for most of the time in the lower part of the range, the stabilising influence of the spot peg on the forward rate should not be completely eliminated, though it should be expected to be smaller the further away the spot rate moved from the official floor.

[1] *Cf.* R. Turvey, "The Speculative Demand for Securities and Carry-Over," *Review of Economic Studies*, Vol. XIX (1950-51), pp. 61-65.

In spite of the difficulties an effort should be made to extract some evidence from the available material. But, to restrict a little the scope of the inquiry, the last two months of 1952 will be left out. The reason for this is that, unlike the rest of the year, for most of November and the whole of December professional interest *arbitrage*, by means of shifting American funds to London, was a paying proposition, and, since such shifting is not subject to any restrictions, it might well have had a considerable influence in the forward market. This leaves the first ten months of the year; the forward series will be examined against the spot series over that period, or such parts of it as appear suggestive. But prior to that a word of explanation for the correlation of the two series which was noted earlier.[1] Such a correlation must be the normal state of affairs when interest *arbitrage* —either professional, or by means of changes of centre of financing trade—is predominant, provided interest rates remain constant. For, in that case, interest *arbitrage* spreads the impact of, say, an increase of demand for sterling over both the spot and forward rates. But interest *arbitrage* was not predominant in the period under consideration, and, therefore, cannot pass as an explanation, though, perhaps, the evidence should lead one to think that it played a greater part than one would be inclined to attribute to it. An alternative explanation is that speculative influences were at work in the spot, as well as the forward market, and that, the balance of feeling being similar in both, they created similar movements. There could be two kinds of speculative influences on the spot market: firstly, some "beat the gun" speculators, with liquid funds at their command, operating in the spot instead of the forward market; secondly, the covering of open positions by a spot transaction which, on occasions, may be more convenient than a forward transaction. But still more important in establishing a close correlation between movements of the spot and forward rates is the deeply ingrained belief of operators that such a correlation

[1]This correlation did not emerge until after 10th March. Nor could it have emerged any earlier because until then the spot rate hardly moved at all, being firmly stuck down to the official floor, where it was maintained only by large-scale official intervention.

is normal. Acting on this belief they tend, therefore, to bring the correlation about, unless other forces preponderate.

Looking, now, to the series of three months forward quotations for sterling on New York, one cannot fail to be impressed by the fact that at no time did they fall below the support price for spot sterling by even as much as 1 per cent. Clearly, the bear speculators were not at any time prepared to back a devaluation of sterling very heavily. The range over which the series fluctuated[1] was $\$2\cdot75\frac{3}{8}$—$\$2\cdot79\frac{15}{16}$, but the number of ups and downs, which is a fair measure of day-to-day stability, was not very great. Indeed, if we leave out the period down to 11th March, during which the spot rate remained practically constant, the ups and downs of the forward series were fewer than those of the spot series: 78 turning points—peaks and troughs—in the former, as against 82 in the latter.[2] The difference is not large; but it becomes more significant when it is remembered that the spot rate was subject to the stabilising influence of official intervention. This intervention was automatic when the spot rate was pushed down to the official floor, but, not infrequently, it operated also, directly or indirectly, when the spot rate stood above the floor.

If we now pass to another possible measure of day-to-day stability—the sum of first differences of each series, treating all differences as positive—we find that for the period 11th March—1st November:

$\Sigma \mid E_{s(t+1)} - E_{s(t)} \mid = 29\frac{3}{16}$ cents; and

$\Sigma \mid E_{f(t+1)} - E_{f(t)} \mid = 37\frac{3}{8}$ cents.

That is to say, we find that the forward series gives a higher

[1] The quotations used in this and in all subsequent cases—whether for spot or forward rates—are those recorded in London at the close of each day's business. The range of spot rates quoted earlier is not, however, confined to those recorded at closing time.

[2] For the present purpose a turning point was defined by the condition

$$(E_{(t+1)} - E_{(t)}).(E_{(t+1)} - E_{(t+1)}) < 0,$$

with the proviso that where the difference $(E_{(t+1)} - E_{(t)})$ is zero the nearest previous non-zero difference should be substituted. The subscript t stands in turn for successive calendar days except Sundays and Bank Holidays. By this definition a turning point occurs whenever the rate moves up (down) after having previously been moving down (up) or been constant, following a downward (upward) movement.

total than the spot series. If we left it at that the inference would be that the day-to-day stability of the latter was greater than that of the former. But it would not be proper to stop here, for, on account of the peg on the spot rate, the forward series moved over a wider range—$\$2\cdot75\frac{3}{8} - \$2\cdot79\frac{15}{16}$, or a difference between lowest and highest points of $4\frac{9}{16}$ cents—than the corresponding range of the spot series—$\$2\cdot78\frac{1}{8} - \$2\cdot81\frac{1}{8}$, or a difference of 3 cents—which gave it a bias towards higher aggregate first differences. Now, the size of the range of movement is not, in itself, very relevant to the concept of day-to-day stability, for it will depend on the magnitude of shifts in expectations, and wide shifts, at intervals, are not inconsistent with day-to-day stability. One way of eliminating the bias is to compare the ratio of the sum of the differences of each series with the ratio of their respective ranges. We then find that:

$$37\tfrac{3}{8}\Big/29\tfrac{3}{16} \quad < \quad 4\tfrac{9}{16}\Big/3, \text{ or}$$

$$37\tfrac{3}{8}\Big/4\tfrac{9}{16} \quad < \quad 29\tfrac{3}{16}\Big/3,$$

and it follows that the day-to-day stability of the forward series, as measured in this way, is greater than that of the spot series. It will not be overlooked that what has been done here, in effect, is to weight the sum of the differences of each series with the reciprocals of their respective ranges. This, though not entirely satisfactory, is a fairly reasonable procedure, and, in any case, superior to any other that it was found possible to devise. If, now, instead of comparing aggregates over the whole period, we break them down into monthly intervals, *i.e.* if we compare for each month separately the sums of the first differences of the spot and forward series respectively, each weighted by the reciprocal of its own range of movement in the month concerned, an interesting fact—more suggestive than any other—emerges. The result of the calculation is as follows:

	March	April	May	June	July	Aug	Sept	Oct
spot series:	$1^{300}/_{690}$,	$3^{38}/_{171}$,	$1^{380}/_{646}$,	4,	$4^{9}/_{27}$,	$2^{19}/_{25}$,	5,	2.
forward series:	$1^{299}/_{690}$,	$3^{108}/_{171}$,	$1^{459}/_{646}$,	$2^{2}/_{3}$,	$4^{5}/_{27}$,	$2^{21}/_{25}$,	$4^{1}/_{3}$,	$1^{36}/_{47}$.

Note: March is only taken from the 11th onwards.

It will be seen that the spot series turns out to be as stable as, or even a little more stable than, the forward series in March (after the 11th), April and May. This, however, is not unexpected, for these are the months during which spot sterling on New York stood well above its support price, and, therefore, diverged most from the conditions of a fully pegged spot rate. On the other hand, in June and September, when the spot rate was very near the floor, the forward series turns out, as it should, considerably more stable than the spot series. July, which was more erratic than June and September, but, on the whole, still close to the floor, also shows the forward series somewhat more stable than the spot series, whilst August, with more than half the time a good deal away from the floor, shows a slight balance the other way. October is a nuisance because it shows the forward series as a little more stable than the spot series, although spot sterling on New York went on rising throughout the month and ended up on the high side of $2.80. Still, this is not very serious,[1] and the rest of the pattern is consistent enough to retain some significance even after being hedged with all sorts of qualifications.

The most prolonged and marked period of stability of the forward series, as compared with other periods of the same series, was that between the middle of August and the end of September. In that period both spot and forward sterling on New York were under heavy pressure on account of the commercial demand for dollars which arose from the temporary permission to engage in commodity *arbitrage* granted by the

[1]October was in any case rather exceptional in that American banks were replenishing their London balances, which they had earlier reduced to inconveniently low levels, either as part of the general bear movement against sterling, or because forward cover for them had become much too expensive on account of the wide discounts on forward sterling on New York. See "Lombard," *Financial Times*, 17th October, 1952; Financial Editor, *Manchester Guardian*, 20th October, 1952; *The Times Review of Industry*, November, 1952, p. 107.

Bank of England.[1] The spot rate was pushed down to its official floor, whilst the three months forward rate was pushed down to the region of $2.75\frac{3}{4}$, and remained there remarkably stable, though it had no official floor to underpin it. This is, perhaps, as clear a case as one can expect to find of elastic demand for or supply of forward sterling from speculative sources placing something like a floor under the forward rate. The short-term prospects for sterling in August and September were better than at any time earlier in the year ; its weakness with respect to the dollar was due to the commodity *arbitrage* scheme, and, as everybody was aware of that, there was no room for interpreting the weakness as an indication of the shape of things to come. In the circumstances, three months forward sterling on New York at $2\frac{1}{4}$ cents. under the lower spot limit was no doubt a very good bargain for sterling bulls and a very poor one for sterling bears. Consider for instance an American importer of sterling goods. He might be inclined to leave his sterling obligation, due in three months, uncovered, speculating on its devaluation. But cheap forward sterling will be an inducement for him to cover—a very strong inducement if he operates on small gross margins. Such evidence as there is shows that a considerable volume of international trade is conducted on very small margins. It was reported, for instance, that profit margins on approved applications for participation in the commodity *arbitrage* scheme ranged from 1 per cent. to as much as 10 per cent., but that the average was thought to be in the vicinity of $2\frac{1}{2}$ per cent.[2] Moreover, on applications which were not approved by the Bank of England—a large proportion of the total submitted—the profit margins must have been still lower. Now, an American importer who operates on a 2 per

[1]Permission was granted to purchase dollar commodities with sterling (which was made convertible for this limited purpose) for export to countries of the European Payments Union. The dollar deficit thereby created was offset by a surplus (or reduction of deficit) with E.P.U.—this surplus accruing wholly in gold because at that time the United Kingdom had exceeded its E.P.U. credit quota. The counterpart of the weakness of sterling on New York was its strength on continental centres.

[2]See " Lombard " in the *Financial Times*, 30th August, 1952.

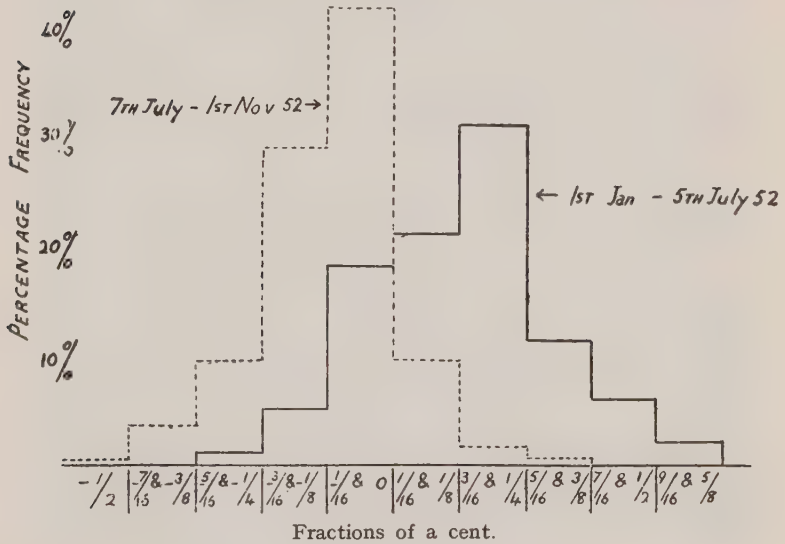
cent. gross margin, and who can purchase three months forward sterling nearly 1 per cent. cheaper than the lower spot limit, will increase his gross profits by nearly 50 per cent. if he covers his sterling obligation forward, as compared with leaving it uncovered until it matures and then purchasing sterling spot at its floor price ; whilst if the spot price stands above the floor when the obligation matures the difference would be still greater. True, he stands to make a very much larger gain, in the event of sterling being devalued, if he does not cover ; but one bird of respectable size in hand is a strong inducement to forego two in the bush of speculation.

It was seen in the last paragraph but one that the proximity of the spot rate to its floor affected the stability of the forward rate. Let us now examine whether it affects also the size of the forward discount. *A priori* it should. For, if initially the spot rate stands above the floor, by the simple process of sinking back to it, it will diminish or wipe out the gains of bulls and the losses of bears corresponding to any given forward discount. It follows, therefore, that, other things being equal, a given forward discount will be less of an inducement to bulls and less of a deterrent to bears the further away spot sterling is from its support price, and, hence, that a drag on the forward rate will be experienced when the spot rate rises above the floor. Following the budget of 11th March 1952, which had the effect of pushing sterling up, one notices evidence of a drag on the forward rate for about a fortnight, when the discount on three months sterling on New York widened to more than 2 cents and remained at that level longer than at any time previously. It is not easy, however, to find any other evidence, on account of the close correlation, which was discussed earlier, between movements of the spot and forward series.

One thing remains to be discussed in this section : the relationship among themselves of rates of forward discount on sterling of different maturities. With professional interest *arbitrage* active, a uniform percentage discount *per annum* would be expected if the *arbitrage* operations were directed towards those maturities which yielded the largest return,

provided the interest differentials between the two centres on short-term loans of different maturities did not differ; and provided, also, the level of interest rates was not expected to change in either centre before the expiry of the longest dated maturity, for, if it were, there would be some preference for either the shorter or the longer maturities according to the direction the interest change was expected to take.[1] What is one to expect, however, when speculation is the active element in the situation? *A priori* there seems to be no reason at all why there should be a uniform percentage margin per annum for different maturities. Let us look at the evidence, however. In the adjoining chart the frequency distribution of the differences between the discount on three months sterling on New York and the quarterly rate of the discount on one month sterling on New York is plotted for two periods as a percentage of the total for each period. The first thing to notice is that in a considerable

DISCOUNT ON THREE MONTHS STERLING ON NEW YORK MINUS DISCOUNT ON ONE MONTH STERLING ON NEW YORK AT QUARTERLY RATE (*i.e.*, ACTUAL ONE MONTH DISCOUNT MULTIPLIED BY THREE)



Fractions of a cent.

[1] *Cf.* P. Einzig, *op. cit.*, chap. XXVI.

proportion of cases the difference has been negligible, indicating that in fact there has been a good deal of uniformity in the rates *per annum* of the discounts on sterling one month and three months forward. What is the explanation ? The banks, it was seen at the end of section II, had some latitude to engage in interest *arbitrage*. This, however, could not account for very much, nor could any other objective factor. One is, therefore, constrained to seek an explanation in the subjective beliefs of foreign exchange operators. If they believe on the basis of their pre-war experience which was shaped under professional interest *arbitrage*, that margins of a uniform percentage *per annum* on different maturities is the norm, they are capable of bringing uniformity about by their own operations. This could be done by (the somewhat misnamed) "time *arbitrage*"[1]: when the percentage discount *per annum* for three months sterling exceeded that for one month, time *arbitrageurs* would be buying three months forward and selling one month forward, whilst in the converse case they would be doing the opposite, thereby closing the gap whichever way it appeared. Thus, to paraphrase Professor Robertson, the relationship would be what it is simply because it was thought that it should be what it is. But it would be departed from if speculators showed some strong preference for either the shorter or longer maturities, and time *arbitrageurs* accepted this as evidence that a divergence from the norm is to be expected. The chart shows a significant shift between the two periods in which it is divided. For the first half of 1952 the percentage discount *per annum* on three months forward sterling tended to exceed that on one month, whereas in the second half (up to the end of October) this tendency disappeared, and was to some extent reversed. This phenomenon could be rationalised in terms of the expected mid-year "hump" in the balance of payments struggle of the sterling area. The theory of the hump had a great influence in financial circles all over the world in the first six months of 1952. The hump was supposed to lie in the middle of the year and it was widely believed that if sterling could go past it without immense discomfort it would

[1] *Ibid.*

reach safe waters. So long as the hump was still ahead, the longer-term prospect for sterling was regarded as more doubtful than the immediate prospect, hence the percentage discount *per annum* on three months sterling tended to exceed that on one month. When the hump was left behind the *raison d'être* of this tendency obviously disappeared—and so did the tendency itself. Supplementary to this interpretation, one might add, that in March, April and May there was a good deal of closing of bear positions against sterling, which must have been reflected in the concentration of demand on forward sterling of shorter maturities, since the bear positions had been contracted earlier, and the deals to close them had to run-off, as nearly as possible, simultaneously with them.[1]

IV

Let us now examine the practical implications for the balance of payments of the conclusions reached in sections II and III. The factual background against which this is to be done is that up to 11th March 1952 short-term interest rates in New York stood very slightly higher than in London, but, after that date, rates in London rose by about 1½ per cent., whilst changes in New York were by comparison insignificant. This means that forward sterling on New York should have been at about par with spot in the first period and at a discount of 1¼—1½ per cent. *per annum* thereafter, if it obeyed the interest parity condition. In practice the forward discount did not, with insignificant exceptions, narrow down to 1½ per cent. *per annum* or less until November, remaining instead for most of the time well above that figure. Up to 11th March forward sterling on New York stood at a discount of more than 2 per cent. *per annum* in all but ten days and, on occasions, at discounts of nearly 4 per cent. Since short-term interest rates were in that period approximately the same in both

[1]There is some analogy—by no means perfect—between the interrelationship of forward margins on deals of different maturities and that of interest rates on loans of different maturities. For the latter see F. A. Lutz, "The Structure of Interest Rates," *Quarterly Journal of Economics*, Vol. LV (1940-41), pp. 36–63; reprinted in the American Economic Association's *Readings in the Theory of Income Distribution*, London: George Allen and Unwin, 1950, pp. 499-529.

centres, the size of the discount measured the gain (as a percentage of turnover) which traders would derive from shifting the financing of their trade from New York to London and effecting transfers from dollars into sterling at the forward rate which favoured the dollar, and from sterling into dollars at the spot rate which favoured sterling.[1] With discounts of more than 2 per cent., gross profit margins of the order of magnitude mentioned in the previous section (p. 109) would be increased very substantially by such a shift and, since no additional risk would be involved, one would expect it to take place on a large scale. It would be continuous, too, since elastic supply of sterling from bear speculators would prevent it from providing its own corrective—the narrowing of the forward discount.

Now, in what way would a shift of trade financing from New York to London be manifested in practice? Clearly, either by the postponement of transfers from dollars into sterling—for actual transfers take place only on the maturity of forward deals—or by the acceleration of transfers from sterling into dollars, or both. Well, this is precisely what happened in the first two months of 1952—with dramatic consequences on the gold and dollar reserves which suffered a large decline—and, after what has been said so far, it would appear that it was a natural sequence of cause and effect. However, contemporary discussion attributed this phenomenon to a different cause: sterling area importers of dollar goods, it was argued, were attempting to beat a possible devaluation of sterling—hence the acceleration of transfers from sterling to dollars—whilst dollar area importers of sterling goods were

[1]Prior to 17th December, 1951, when forward as well as spot sterling were fully pegged, the Bank of England was prepared to offer cover to *bona fide* traders by buying foreign currencies forward at a discount on sterling of 1 per cent. *per annum* and by selling them forward at a premium on sterling of 1 per cent. again. So that for transfers from sterling into dollars a discount of 2 per cent. *per annum* on forward sterling after 17th December simply increased the advantage of spot over forward transactions which was already there, whilst for transfers from dollars into sterling it reversed the disadvantage of forward transactions into an advantage.
There was an unofficial market for forward sterling in New York before 17th December, 1951, but it was narrow and mainly patronised by speculators.

doing their best to let it take place before they acquired sterling to meet their obligations—hence the postponement of transfers from dollars to sterling. Now, the first part of this argument is a *non sequitur*, for if importers of dollar goods wanted protection against a devaluation of sterling they could obtain it by covering their dollar obligations forward, without that is to say, accelerating their transfers.[1] If accelerate they did, nevertheless, it must have been due to the commercial advantage of cheaper spot dollars, unless it was to ignorance of the existence of forward exchange facilities. On the other hand, the second part of the argument is valid, in that trader-speculation is a sufficient cause for the postponement of transfers from dollars into sterling. Unfortunately, it is not possible to measure the importance of the commercial factor, *i.e.*, the relative cheapness of forward sterling in terms of dollars, against the speculative factor, in producing this result. It would be foolish, however, to pitch the claims of the commercial factor too high. For one thing, the postponement of transfers from dollars into sterling was going on throughout the second half of 1951 when only the speculative factor was in operation. For another, when there is a strong bear feeling against sterling, the size of the anticipated capital gains from its expected devaluation is likely to overshadow, in many cases, the advantages from the relative cheapness of the forward quotations, which by comparison must appear small. What can be said, however, with confidence is that had there been no speculative factor in operation in the first two months of 1952 some displacement-in-time of transfers would have yet taken place on account of the commercial factor ; and, more to the point, that such time displacement of transfers as had been induced by speculation would become " frozen " on account of the commercial factor even if bear speculation

[1]This point was not sufficiently appreciated by the authors of the United Nations Report on *Measures for International Economic Stability* (November 1951), which states that " A rumour of currency devaluation *that advanced exchange transactions relating to imports by an average of one month*, and delayed transactions relating to exports and other receipts by one month, would lead to a drain on reserves equivalent to two months imports." (p. 33 ; the italics are not in the report).

against sterling subsided somewhat. Take, for instance, the American importer of sterling goods whose imports are being financed in London so that he can be in a position to owe sterling and gain from the devaluation of it which he expects. If at some stage he changes his mind about the prospect of sterling he will not shift the financing of his imports to New York; he will simply cover his liabilities by a purchase of forward sterling, to take advantage of its cheapness, if the cost of borrowing in London does not offset this advantage. The transfer of dollars is not, thereby, materially advanced, for it will only take place on the maturity of the forward deal.

In March 1952, however, the authorities were under a clear obligation, in view of the perilous state of the reserves at that time, to take steps to reverse the time displacement of transfers that had taken place. The bank rate mechanism was, therefore, called upon to perform the only predictable function that had been left to it : not to create confidence in sterling—this it might do on occasions, but it would lack consistency, which is the hallmark of what one calls a mechanism—but to ensure that after some degree of confidence had, somehow, been restored, it would be expressed in an acceleration of transfers into sterling and a postponement of transfers out of it. In other words, the function of the steep rise of short-term interest rates introduced on 11th March 1952 was to unfreeze, in the event of an improvement in confidence, the time-pattern of transfers, which had developed at the expense of the sterling area's gold and dollar reserves, by knocking off a large proportion of the disparity between the discount on forward sterling and its interest parity, or of such part of it as might have been expected to remain after the presupposed improvement in confidence.[1] Thus the wheel has turned full circle : whereas Keynes, it will be remembered from section I, advocated the adjustment of forward rates to offset interest differentials as a means of monetary management, the new management which was operated in 1952 has worked in the reverse direction by adjusting the interest differentials to the forward margins.

[1] *Cf. The Banker*, April, 1952, p. 201.

The need for this was, clearly, the consequence of the unpegging of forward sterling which allowed a discount to appear. That a rise of bank rate should have been required to compensate for its consequences is a ground for criticism of the action. But the basic fault of the system is that it has cumulative effects in both adverse and favourable circumstances: when there is a strong bear feeling against sterling the forward rate is forced to a large discount, inducing a time displacement of transfers on purely commercial considerations, and thereby imposing a strain on the reserves additional to that imposed by bear speculation, *i.e.*, at a time when it can be least afforded; when the bear feeling is reversed the forward discount shrinks, and it becomes commercially advantageous to reverse the earlier displacement of transfers, thereby boosting the reserves when it is least necessary.

Manchester. JOHN SPRAOS.

The British Export Trade Research Organisation: 1945-1952[1]

> " If there be any gaps in information or organisation, BETRO, a monster as creditable to British enterprise after his kind as Pluto and Fido after *their* kinds, stands ready to fill them. That 50 per cent. is practically in the bag ! "
>
> Professor D. H. Robertson.[2]

The British Export Trade Research Organisation (BETRO) was established in 1945 by a small group of business men who believed that overseas market research would be of great assistance to British entrepreneurs trying to recover or expand their export markets in the post-war world.

It is possible that time and events will prove their confidence in the value of overseas market research to be justified. As far as BETRO itself was concerned, however, there can be no doubt that it proved, on balance, to be a failure —a fact which was formally recognised on January 4th, 1952, when the organisation announced it was going into voluntary liquidation.

The fact that BETRO constituted one of the very few attempts to improve the efficiency of the organisation of our export trade which has been made since the war gives its brief, sad story particular interest. Our purpose in what follows is, *first*, to tell this story as fully and accurately as possible, *second*, to explain why BETRO did not succeed ; and *third* to draw certain conclusions from the experiment concerning the future development of the British export trade.

I. The History of BETRO : 1945-1952.

The first step towards the setting-up of BETRO was taken in 1944, when discussions began between the Board of

[1]This paper was written whilst I was in receipt of a grant from the Houblon-Norman Fund. In writing it, I have benefited greatly from information provided by Dr. Mark Abrams, Mr. Tom Cauter, Mr. Roger Falk, Mr. Harry Henry, Mr. A. G. Jones and a number of other market research experts. Mr. S. R. Dennison and Professor R. S. Edwards were good enough to read and criticise earlier drafts of this paper. Any errors which remain are, of course, my sole responsibility.

[2]"The Problem of Exports." *Economic Journal*, 1945, p. 321.

Trade and certain advertising and commercial interests concerning the post-war export plans of British industry. These discussions were followed by a series of conferences with many of the business and industrial organisations concerned ; and it was in the course of those conferences that the idea of BETRO was formulated.

The small group of industrialists and advertising executives actively engaged in this inquiry quickly came to the conclusion that lack of information would be one of the severest handicaps that British exporters would encounter in their struggles to regain or expand their overseas markets. Overseas market research was an obvious method of obtaining such information ; and the group decided that such research—much neglected in pre-war days—should be in great demand after the war. They also came to the conclusion that overseas market research on the scale envisaged could not be carried out by the existing market research agencies. So the idea of BETRO—a new specialist agency—came into being.

In February, 1945, the small group of industrialists and advertising executives who had first conceived of the idea of BETRO appointed from amongst themselves a Formation Committee. This Committee, composed of six industrialists and three advertising executives, took upon itself the task of actually setting up the new organisation and of obtaining wider support from the various branches of British industry. In March, 1945, the Committee published a manifesto[1] in which it set out the aims and functions of the new organisation in the following terms :

> " BETRO will be a self-supporting but non-profit making organisation. Since its structure will be co-operative it will have no need to make profits : it will have only the obligation to provide necessary services efficiently and at the lowest possible cost. Since it will be maintained by its members, with no external contributions, it will have to be self-supporting. Its objectives will be to obtain and place at the disposal of all its members, primarily by means of market and consumer research, such

[1] *A Plan for Market Research Overseas*. March, 1945.

information—whether of a general or specific character—as may be necessary for them to appraise the existing situation in old markets and to develop them, to discover new markets overseas, and generally to re-establish and increase their overseas trade."

The manifesto attracted wide attention ; and somewhat to their surprise, the Formation Committee found no difficulty at all in obtaining the support of a considerable number of firms. The response was so encouraging that the Committee had no hesitation in deciding that the organisation should be set up straight away ; and, on May 18th, 1945, BETRO was incorporated as a non-profit-making concern, limited by guarantee and having no share capital.

The initial financial resources of the organisation were provided by the subscriptions of the " founder members " who at the date of incorporation numbered ninety-nine. All of these founder members, comprising in the main large industrial concerns, banks and advertising agencies, undertook to subscribe £500 annually for a period of three years. This arrangement was intended to be a temporary expedient only ; its purpose was simply to provide BETRO with finance at the outset of its career, for it was the hope of its founders that BETRO would be able so to establish itself within three years that, by the time the founder-member subscriptions came to an end, the organisation would be able to support itself by the revenue it derived from ordinary membership subscriptions and from research fees.

Ordinary membership of the organisation was made available to all firms whose normal export activities were concerned with the export of British goods and services from the United Kingdom. Each ordinary member was required to pay an annual subscription of £100[1] ; but members were allowed to withdraw from the organisation at three months' notice. Another type of membership, known as affiliated membership, was made available early in 1946 for trade associations and export groups under which, for an annual

[1]Founder and ordinary membership subscriptions were allowable as an expense for income tax purposes.

subscription of ten guineas, an industrial group having common interests could commission surveys intended to benefit the whole group. This membership could not be used to commission surveys intended to benefit any single member of the group. It was hoped that the contacts thus established between BETRO and industry would lead to a wider understanding of BETRO's work and, consequently, in time to a larger ordinary membership.

The original intention was to restrict BETRO's services to its ordinary members. However, it soon became apparent that members would not provide sufficient business; consequently from 1948 onwards, BETRO's services were made available to non-members also. The total number of members of all kinds on March 31st, 1946, was 218 of which ninety-nine were founder members. The total number of members increased steadily from 1946 to 1948 but after 1948 it declined steadily. The ordinary and founder members comprised a wide variety of industrial and commercial undertakings. In November, 1951, for example, BETRO numbered amongst its ordinary members sixteen banks, seventeen advertising and press agencies and two public corporations (the Port of London Authority and the Mersey Docks and Harbour Board). The other 120 members were, in the main, manufacturing concerns ranging from such giant firms as Imperial Chemical Industries, British Insulated Callenders Cables, the Steel Company of Wales and Tube Investments, to quite small firms.

In the period May, 1945—March, 1947, founder membership subscriptions accounted for nearly 75 per cent. of BETRO's total income. The rest of BETRO's income in this period came from ordinary and affiliated membership subscriptions and from fees charged for carrying out research investigations. Since the total revenue which BETRO derived from these sources mounted to about £26,000 in these two years whereas its expenditure amounted to about £113,000, it is clear that BETRO in the third year of its existence was faced with a serious financial crisis. The gap between these two figures which at that time was closed by the founder-membership subscriptions would soon have to be closed by some other

means. Not altogether surprisingly, these other means turned out to be a Government subsidy.

In July, 1947, Sir Stafford Cripps, then Chancellor of the Exchequer, speaking at a luncheon arranged by BETRO, announced that the Government had decided to help BETRO financially by paying half of any deficit incurred in each of the subsequent five years, subject to the total amount involved not exceeding a certain stipulated figure. Sir Stafford added, that though BETRO was providing a valuable service nevertheless it was essentially a service which must be paid for by the beneficiaries and not by the taxpayer[1].

Table I summarises the financial history of BETRO from 1945 to 1951. It will be seen that BETRO derived its income from four sources: (*a*) founder member subscriptions; (*b*) ordinary member subscriptions; (*c*) research fees, and (*d*) the government grant-in-aid. In its first two years of existence, 1945/6/7, BETRO relied on the founder-member subscriptions to meet its deficit; in the year 1947/8, BETRO relied on these subscriptions and on the Government grant-in-aid to meet its deficit; and in the years 1948/9/50 BETRO relied on the Government grant-in-aid to meet its deficit.

This was obviously an unstable equilibrium. The Government grant-in-aid would not be available to cover BETRO's losses after March, 1952. Some radical change in the financial structure of BETRO would clearly have to be made if the organisation was to continue its operations for

[1] *Board of Trade Journal*. July 5th, 1947, p.1109. The exact terms on which this subsid would be given were announced by Mr. Harold Wilson then President of the Board of Trade, in the House of Commons on October 30th, 1947, viz.:

> "An undertaking has been given subject to the grant of the necessary approval by Parliament, to provide an annual contribution for the next five years within a maximum of £150,000 in all up to half of deficiency between annual expenditure and the revenue from commissions executed, subject to an equivalent contribution from other sources, mainly industry. The revenue derived from members, including manufacturers, merchants and other interests concerned with the export trade is expected to meet this charge."

TABLE I.

BETRO'S FINANCES, 1945-51.

Item	1945/6	1946/7	1947/8	1948/9	1949/50	1950/1
EXPENDITURE.						
1. Salaries, Rent, Travelling, etc. ...	27,277	77,472	66,517	74,774	69,339	60,238
2. Fees Payable for Research work ...	—	1,443	3,283	10,773	13,030	11,802
3. Overseas Offices ...	—	6,574	9,728	19,317	21,414	26,476
4. Transfer to Founder Members Reserve a/c.	—	—	30,747	—	—	36
9. Total expenditure ...	27,277	85,489	110,275	104,864	103,783	98,552
INCOME						
9. Membership subs. :						
Founder	40,773	49,088	47,999	9,641	—	—
Ordinary	7,280	12,827	14,912	23,995	21,699	19,044
Affiliated ...	—	215	347	442	470	490
10. Fees receivable for research work ...	—	5,374	11,640	28,349	39,813	38,838
11. Other income ...	2,005	4,583	4,703	4,065	3,752	6,596
12. Total income ...	50,058	72,087	79,600	66,492	65,734	64,968
13. Gross Deficit or Surplus. (—)or (+) ...	+22,781	—13,402	—30,675	—38,372	—38,049	—33,584
14. Government Grant	—	—	31,250	35,000	30,900	33,860
15. Less capital adj. ...	—	—	503	3,471	1,627	312
16. Plus previous year adjustments ...	—	—	—	250	2,920	36
17. Net Grant	—	—	30,747	31,529	32,193	33,584
18. Net Deficit or Surplus (—) or (+)...	+22,781	—13,402	+72	—6,843	—5,856	—

NOTE TO TABLE I.

It should perhaps be explained that the total sum received from the Government by BETRO was not the sum of the items in row 17. It was the practice to adjust the grant received in any year for amounts applied to capital expenditure during that year. That is to say, the whole of BETRO's current capital expenditure was a first charge on the grant-in-aid ; the amount remaining was then applied to meet the deficit between current income and expenditure. Certain adjustments were also made in the current year in respect of under-payments of the grant for the previous year. Thus, the total amount received from the Government is the sum of the original amount of each year's grant plus the adjustments for previous years' under-payments. It will be seen that the total sum involved in the four years 1948-1951 was £134,216. *cf.* Mr. Peter Thorneycroft, President of the Board of Trade, *Hansard*, March 20th, 1952.

more than a year or so. In early 1950, an attempt was made to deal with the problem, viz. :

> " In April, 1950, the British Export Trade Research Organisation . . . went through a major metamorphosis. Set up at the end of the war to help British exporters solve some of their marketing problems overseas, the organisation was in danger of spreading its resources too thinly. It had become an open secret by the end of 1949 that a surgical operation was needed. The first sign . . . . was the appointment of Mr. Roger Falk as director-general. He undertook a very drastic pruning of staff. And from his efforts there quickly emerged an agreement with the Federation of British Industries to pool resources, to cut out . . . overlapping[1].

This " surgical operation " was carried out on the fundamental assumption that from March, 1951, onwards BETRO was to be financially self-supporting. It was decided that this could only be achieved if (*a*) BETRO concentrated solely and simply on specific market research and discarded its intelligence services, and (*b*) BETRO made more extensive use of overseas market research agencies and reduced the number of its own overseas representatives.

(*a*) Although BETRO was set up to carry out market research, it was also the intention of its founders that it should perform other allied functions ; such as giving advice about the selection of export agents, publishing news of trade openings, notifying members of changes in foreign import regulations and so forth. In short, BETRO was designed to provide members with a general information service as well as with facilities for executing specific market surveys.

There were, of course, a number of other organisations providing these ancillary services ; the most important of which was the Board of Trade. The danger that BETRO might overlap with this part of the work of the Board of Trade had been recognised at the outset ; and in March, 1946, an arrangement was made between the two organisations whereby BETRO agreed to try to supplement and not to compete with

[1]Is BETRO Pulling its Weight ? *Director*, June, 1951, p.59.

the work already being done by the Export Promotion Department (as it was then called) of the Board of Trade.

Under this arrangement BETRO agreed to concentrate on specialised detailed market surveys which would be made available only to its members ; the Board of Trade on the other hand would continue to provide its general overseas market reports upon request for any reputable inquirer. The division of labour as far as market surveys were concerned was clear enough. But in regard to the provision of general export information and advice, the 1946 agreement failed to lay down any clear lines of demarcation. It simply said that the Export Promotion Department and BETRO would co-operate as far as possible. They would exchange information and advice ; they would build jointly a library of foreign catalogues ; and their overseas representatives would co-ordinate their activities. But that was all ; the guiding principle underlying this part of the agreement seemed to be that " one can't have too much of a good thing."[1]

BETRO's financial difficulties, in the course of time, enforced a more economical approach to this matter. In April, 1950, an agreement was signed, this time between BETRO and the Federation of British Industries, whereby BETRO undertook to concentrate simply and solely on market research in return for an undertaking from the Federation that it would " promote the wider use of BETRO for market survey and research work among F.B.I. members." The suspension by BETRO of its general information service, which this agreement involved, automatically eliminated overlapping not only with the F.B.I. but also, of course, with the Commercial Relations and Exports Department (as the Export Promotion Department was now called) of the Board of Trade[2].

(*b*) When BETRO was set up in 1945, ambitious plans were put forward concerning its future overseas development, *viz.* :

[1]A joint committee of the Export Promotion Department and BETRO was set up to review the results of this arrangement and to decide future policy. *Board of Trade Journal*, March 30th, 1946, p. 364.

[2]*Board of Trade Journal*, April, 29th, 1950, p. 858.

> " The full development of BETRO's plans will be effected in stages. They aim at providing a world-wide organisation divided into regional spheres of control, each under senior management assisted by general research officers, consumer research specialists, statistical services and field organisations—either directly employed or employed by local agencies . . . It is proposed to use local research organisations to undertake specific market investigations where suitable and where the volume of work does not justify a BETRO branch."[1]

These plans were partially carried out in the years 1946-8; branch offices were set up in a number of countries, including Sweden (1946), Argentina (1946), U.S.A. (1947), Canada (1948) and South Africa (1948).

But none of these offices developed quite along the lines envisaged. This was largely due to lack of business. It was very soon realised that the volume of overseas research work forthcoming was not going to be sufficient to make the maintenance of overseas branches an economic proposition. Certainly, the idea that some of these branches would be equipped so as to constitute independent research units complete with field investigators—an idea which was undoubtedly in the minds of some, at least, of the founders of BETRO—proved to be quite absurd in the light of actual developments.

These overseas branches were, therefore, obvious targets in an economy campaign ; and in 1950/1, the branches in Sweden and South Africa were closed down. The Argentine office had been closed down in 1949 but this closure was due to special, local difficulties. The American and Canadian offices were kept going more or less as evidence of BETRO's willingness to help the dollar export drive[2].

Thus, the 1950 reorganisation attempted to save BETRO by closing down both its overseas branches and its general information services. The accounts for the year 1950/1951 show that this policy of retrenchment had some success.

[1] *Board of Trade Journal*, March 30th, 1946, pp. 364-365.

[2] *cf.* R. Falk (Director-General of BETRO). Letter to *Director*, July, 1951.

BETRO's total expenditure in that year was £98,552 as compared to the previous year's expenditure of £103,783. But the reduction was not nearly large enough ; the gross deficit in 1950/51 still amounted to £33,584.

The government grant-in-aid was, of course, available to meet this deficit ; but from March 31st, 1951, onwards, BETRO was absolutely on its own. The economy campaign was continued though, naturally, it was difficult to go on reducing services without affecting revenue. In addition the most " strenuous efforts were made to obtain additional work that would make (BETRO) self-supporting."[1] But both these efforts and the economy campaign proved insufficient in the end ; and, in January, 1952, the Council of BETRO announced its decision to put the organisation into voluntary liquidation.

II. The Reasons for BETRO's Failure.

We are now in a position to begin looking for reasons why BETRO did not succeed. The Council of BETRO, in their statement announcing the voluntary liquidation of the enterprise, explained that:

> " This step (voluntary liquidation) is made necessary by the impact of the re-armament programme on the export drive and the fact that the value of overseas market research is as yet inadequately appreciated by industry."

This explanation is quite satisfactory as far as it goes ; but there is a good deal more to be said than this. One's immediate reaction to such an explanation is to ask whether " inadequate appreciation " and " the impact of the re-armament programme " might not also have affected the development of research carried out in the home market since the war. If the answer to such a question showed that the domestic market research agencies had been able in this period to " drum up " a satisfactory volume of business, then clearly, the further question would arise why exactly it was that the reasons suggested by the Council affected BETRO so severely but not the domestic agencies.

It seems necessary, therefore, to consider briefly the fortunes of the domestic market research agencies since the

[1] *cf.* R. Falk. Letter to *Times*. January 24th, 1952.

war : and, in the light of this information, to consider the implications of the explanation put forward by the Council. British market research agencies can be put into four classes : (*a*) subsidiary companies of advertising agencies, (*b*) research departments of advertising agencies, (*c*) independent research agencies, and (*d*) research departments of manufacturing firms. The revenue of the independent and subsidiary agencies is almost entirely derived from (*a*) producers of consumer goods, and (*b*) government departments and other non-commercial organisations.[1] The total amount of this revenue (or in other words the total expenditure on " outside " market research by manufacturers and non-commercial organisations) is not known precisely, but informed opinion has estimated their revenue in 1951 at between £675,000 and £725,000. If £200,000 to £275,000 is added to this figure to allow for the revenue of the research departments of advertising agencies and manufacturers, we arrive at a figure of between £875,000 and £1,000,000 for the total domestic expenditure on market research.

As far as one can tell, this revenue has been sufficient to provide the domestic agencies with satisfactory profits ; at least, profits seem to have been high enough to have induced a quite considerable amount of growth since 1945. If this is so, then the question why it is that the domestic agencies flourished whilst BETRO withered away obviously requires investigation.

Table 2 shows that the research fees received by BETRO never amounted to more than £40,000 annually, *i.e.*, less than 5 per cent. of aggregate domestic research revenue. Why did BETRO fail to obtain a much larger percentage than that ? This, clearly, is the crucial question which we have to answer.

In order to be able to answer this question, we must first of all appreciate that the term " market research " covers a multitude of different activities. These activities can be listed as follows :

[1]A large proportion, perhaps 50 per cent. of the independents' revenue is derived from those advertising agencies which do not possess a research department themselves ; but the " final buyer " of the findings of the independents is, of course, either (*a*) or (*b*), not the advertising agency.

1. Arm-chair Research : the collection of published information bearing on a specific marketing problem.
2. Informed Opinion Surveys : the collection of the opinions of a few experts on the solution of a particular marketing problem.
3. Distribution Analyses : the critical analysis of the distributive methods of manufacturers.
4. Trade Surveys : the collection of information from industrial users, retailers and wholesalers concerning the capabilities of a particular product.
5. Media Research : the collection of information from newspaper readers and other publicity media customers in such a way as to give an indication of the most efficient ways of distributing advertising expenditure.
6. Product tests : the trial of a product on a group of potential customers.
7. Consumer Surveys : the collection of information from consumers of a product, actual and potential, concerning its price, packing, quality and any other factor which may have influenced their purchasing decisions.
8. Public Opinion Surveys : the collection of information from voters, radio listeners and other social groups concerning questions of interest to organisations such as the B.B.C., the British Institute of Public Opinion, etc.
9. Retail Shop Audits : the auditing of stocks held by shops and purchases made by shops from wholesalers and manufacturers.

Now, of these nine types of research, activities 5 to 9 which we will call " statistical research," provided in the period 1945—1951 the bulk of the income received by the domestic research agencies ; whereas, activities 1 to 4, which we will call " specialist research," provided a considerable part of BETRO's earnings during this same period. It seems necessary, therefore, to inquire, *first* why was it that BETRO received relatively little from activities 5 to 9 ? and *second*, why was it that BETRO did not receive more from activities 1 to 4 ?

(1) Statistical Research.

The first point to be made is that there were two types of statistical research—accounting for a large part of total domestic earnings—from which BETRO did not and could not reasonably have been expected to have derived much revenue, namely, (*a*) activity 9—retail shop auditing and (*b*) activities 5 and 6—advertising research.

(*a*) Two of the domestic agencies provide a retail auditing service for British manufacturers[1]. BETRO did not attempt to provide this kind of service and there seems to have been little demand for it from exporters. The total amount of domestic revenue derived from such research probably amounted in 1951 to about £275,000.

(*b*) A considerable part of the work of the subsidiary and independent agencies is concerned with increasing the efficiency of advertising techniques. This is a kind of research which was extremely unlikely to be given to BETRO if there was, indeed, any demand for it at all. Its volume would depend upon the volume of our overseas advertising ; and it seems that this is very small. A fair estimate of the proportion of the total income received by the agencies doing the sort of work accounted for by this type of research would be about 30 per cent., *i.e.*, about £200,000—£225,000.

Thus domestic expenditure on these two kinds of research together amounted to about £500,000. This means that the total income received by domestic agencies from consumer and public opinion surveys amounted to about £400,000—£500,000. Since BETRO's total income amounted at the maximum to only £40,000 or so per annum—and since this figure includes income earned on account of " specialist " market research work—it is clear that BETRO's income from consumer surveys

[1]For details of this type of research, see *The Times Review of Industry*, October, 1951, and *Scope*, February, 1950. The term " marketing research " is sometimes used in this country to distinguish this research from other kinds of market research. In view of the American usage of the term (as an umbrella term), this endeavour seems ill-advised. It would be better to use a more precise term such as " retail shop-auditing " for this kind of activity and thus avoid a good deal of unnecessary confusion.

was only a small fraction of the volume of the survey business undertaken in the home market. Why was this ?

The answer to this question is quite obvious, namely, that the value of export business is, for most firms, much smaller than the value of their home business. Moreover, this smaller total amount of trade is, of course, distributed between a large number of different markets. This fact is of great importance for two reasons : (*a*) a consumer survey is a fairly costly project[1], and (*b*) the results of a consumer survey carried out in one export market cannot usually be applied to other export markets.

It is not surprising, therefore, that manufacturers are more reluctant to commission overseas surveys than domestic surveys. A full-scale consumer survey of the home market may seem worth while, since, if it is properly executed, it can provide valuable information about the major part of the firm's business. But a similar survey of an export market may very well appear to be uneconomic since the results of the survey would in fact relate only to that very small part of its business which was done in that particular export market.

It is, of course, possible—and we will assume it to be so for the sake of argument—that a consumer survey of an export market may in the event turn out to be profitable. The difficulty is that the exporter has to be convinced that it will be profitable and, in actual practice, this is not at all easy. He has to make his decision on the basis of very imperfect knowledge for, as Professor A. G. Hart has pointed out :

> " Unfortunately, it must remain eternally a matter of guesswork just where the margin of profitable estimation and planning lies. For it is impossible to tell accurately whether assembling more data and planning more carefully will yield enough improvement in income to pay for itself . . . Something can be done by comparing past experience under hasty judgments with past experience

[1]The cost of a consumer survey varies according to the size of the sample which is taken and the length of the questionnaire, but the normal survey carried out in the home market based on the usual sample of 3,000 interviews costs about £2,000. A large proportion of this total cost is accounted for by salaries.

under estimates more carefully framed ; but the experiences available are not normally entirely comparable. Nonetheless, a choice exists between less unreliable estimates at higher cost and more unreliable estimates at lower cost ; and a decision must be reached."[1]

Under such conditions, prejudice, personal contacts, hearsay and other accidental and irrational factors play a large part in determining which way the decision goes. In such matters, BETRO was at a disadvantage ; it was a new and untried organisation, it lacked contacts with industry, some of its personnel did not inspire confidence, and some of its work had been of poor quality. Moreover, since many of the firms who were accustomed to spending large sums on domestic market research had extensive overseas connections, BETRO was forced to look for business to firms that were unaccustomed to buying such a service. Missionary work, a time-consuming business, was, therefore, required.

These considerations lead us quite definitely to the conclusion that it was not at all surprising that BETRO was not able to secure more revenue from overseas consumer surveys. This conclusion is reinforced when three further factors are taken into account, each of which tended to reduce still further the demand for overseas surveys, as far as BETRO was concerned, *viz.*,

(*a*) that export merchants who are responsible for a large part of our export trade are, in general, for various reasons, not interested in overseas consumer surveys;

(*b*) that a part of total domestic research expenditure is due to the close connection which exists between advertising and market research agencies, a connection which BETRO did not possess;

(*c*) that BETRO had to compete for the limited amount of work available with both domestic and overseas market research agencies.

[1] *Anticipations, Uncertainty and Dynamic Planning.* New York, 1951, p.81.

There were, however, two factors, of minor importance which should be mentioned which operated in BETRO'S favour, namely, (*a*) the introduction in 1949, by the Export Credits Guarantee Department of special market research guarantees for dollar exporters, and (*b*) the use of special funds for this purpose by various joint export organisations.

(*a*) *ECGD Guarantees.* In October, 1949, the ECGD decided to try to encourage exporters to develop or expand their dollar export trade by providing them with additional cover against losses. Under these arrangements, the ECGD offered to guarantee a dollar exporter against loss arising out of three types of activity undertaken to develop or expand his dollar trade, namely, market research[1], product testing and stock holding. These special facilities were used by BETRO to try to persuade exporters to commission surveys but the response was not enthusiastic ; in the period April, 1949, to August, 1951, only twenty-nine surveys representing a total expenditure of about £20,000 were guaranteed by the ECGD. Whilst a large part of this expenditure would probably not have been made in the absence of the guarantee, clearly the net addition to BETRO'S revenue could not have been great.

(*b*) *Joint Export Organisations.* Domestic market research agencies have, in general, to look to the individual manufacturer or advertising agency (as well as to Government Departments and other non-commercial organisations) for their business. An additional source of income exists in the export trade, however, where since the war, several joint export organisations have displayed considerable interest in sponsoring group overseas market research. Three organisations, the Cotton Board, the Leather Industries Export Corporation and the

[1]The details of this arrangement were as follows ; the ECGD offered to guarantee an exporter up to 50 per cent. of the cost of a market survey carried out by a recognised U.K., U.S. or Canadian market research organisation. If the survey showed no prospect of sales then the Department guaranteed to pay the exporter a percentage of the cost of the survey immediately ; and if the survey were favourable but sales failed to reach the level anticipated for no fault of the exporter, then the Department guaranteed to pay the exporter a percentage of the net loss made by him on the transaction.

National Wool Textile Export Corporation, each of which have been financed by a statutory levy on the members of each respective industry, have shown an interest in such research: and it appears that BETRO'S income benefited considerably as a result of their interest.

It should be noted, in this connection, that BETRO also received considerable income from two official or semi-official commissions: one, from the Board of Trade, to inquire into the packaging of British goods for Canadian markets, and the other, from the Dollar Exports Council, to inquire into the costs and methods of distributing British goods in dollar markets.

(2) Specialist Research.

So much for BETRO'S income—or rather lack of income—from consumer surveys. Let us now turn to consider the reasons why BETRO failed to obtain more revenue from " specialist " research as we have called it.

Apart from supplying general export information[1] free to members, BETRO'S undertook two other types of market research, apart from consumer surveys, *viz. marketing investigations* and *trade surveys*. The first category comprised (*a*) the digging-out of information already available in print; in BETRO'S own words:

> " A practical and very common example is the ' screening ' of the import licence and quota position for a certain product throughout the world. This type of investigation requires no special technique except a knowledge of the sources of information and their accuracy . . . BETRO's function . . . is speed, accuracy and the preparation of comparative reports which present clearly the salient points."

[1]This service was made available to members in the shape of a daily intelligence sheet and a monthly review of overseas trade conditions. In these publications, BETRO tried to provide up-to-date information about such matters as tariffs, price controls, import licenses, trade openings, tenders, trends in balance of payments, etc. All of this information was general in the sense that none of it was aimed at the solution of the export problem of a particular exporter. Domestic market research agencies, for obvious reasons, do not provide a similar service for their clients.

(*b*) the collection of " informed opinions " on the market prospects of a particular product ; BETRO pointed out, in this connection that:

> " Experience in this work counts for a lot ; it requires a special blend of commercial background and careful analytical training."

and (*c*) the examination of the distributive methods adopted by manufacturers in their overseas markets[1].

Trade surveys, the other type of research, were investigations of the market prospects of a product bought by business men. The results of such surveys were based on a fairly large number of interviews with industrial users, wholesalers or retailers but could normally be carried out by one highly-trained investigator. The main requirement was that the investigator usually needed a fairly close and detailed knowledge of the technical nature of the product concerned in order to do the job efficiently[2].

[1]An example of this type of Survey has been described in detail as follows: " Another typical investigation dealt with an entirely new overseas market for an item of consumers good—a proprietary product used in cooking. First, a preliminary report was prepared on the total size and general characteristics of the market, together with existing facilities for distribution, and in this was incorporated information about statutory food regulations . . . The purpose being to estimate the possibility of developing a continuing market, special inquiry was conducted into the reasons for success or failure on the part of competitors in that particular territory and into possible variations in price, packing or marketing methods which would improve the prospects, not only for gaining a share of present business but also for an expansion of total sales."
Midland Bank Review, February, 1947, "Britain's Export Campaign—Information and Research," p.5.

[2]The *Midland Bank Review* has provided a description of a survey of this type; " (an example) from a capital goods industry relates to possible export markets for metal sifting covers used in grain-milling. In this case a sample was taken of mill-owners in the country concerned, and answers were obtained, and then collated and analysed, to questions concerning such matters as milling capacity and output ; numbers of machines using sifting covers ; origin, type, relative efficiency and estimated life of covers used, as affected by climate, metallic composition and so forth ; and normal size of spare stocks of covers. At the outcome of the survey, the manufacturer gained a much clearer and more precise picture than would have been possible otherwise of the likely scope for expansion in the particular market, the competition to be expected there and the design which would give his own product the maximum chance of expanding sales."

We have already pointed out that the major part of BETRO's earnings was derived from this type of specialist market research. The question for which we must provide an answer is why it was that BETRO was not able to earn more from this type of work than it did. The answer seems to be, briefly, that BETRO was unable to compete, as far as trade surveys were concerned, with the exporter himself and, as far as marketing investigations were concerned, with the Commercial Relations and Exports Department of the Board of Trade and other similar export organisations.

As far as *trade surveys* were concerned, it was obviously necessary for BETRO to show that it could do this kind of work more efficiently than could the exporting firm itself. BETRO put forward two arguments to show why this was so : (*a*) that it would enjoy economies of large-scale organisation, and (*b*) that its reports would be impartial and objective.

Neither of these arguments were able to convince manufacturers, however, who pointed out that BETRO could not possibly know as much about their business as they did themselves ; and that where the product was a highly specialised one, no outside agency whatsoever would be capable of carrying out a useful survey.

This type of argument has been, and is still, frequently used with respect to other kinds of market research. But it carried particular force in the case of trade surveys which were often within the technical competence of the export sales manager or whoever else was responsible for the export policy of the firm concerned. In claiming a special expertise in this work, BETRO was forced in many cases to issue a direct challenge to the efficiency of the individual entrepreneur—or his export manager. Where a manufacturer had already an extensive overseas organisation, even the most energetic advocates of BETRO uttered this challenge in rather a half-hearted fashion. Indeed, the director-general of BETRO, Mr. Roger Falk, went so far as to admit, in a letter written to *Director* in August, 1951, that it was really the small and medium-sized firms which sold their goods through an export agent who " most needed objective, dynamic measurement of

their market opportunities and performance." However, though this was probably true, to develop this type of work in such a field would clearly be a time-consuming business ; and BETRO could not afford to wait.

The failure of BETRO to obtain more revenue from *market investigations* was undoubtedly due to the severe competition it encountered from a number of official and semi-official export organisations. Exporters can obtain information of this type, free or at a nominal charge, from the Commercial Relations and Exports Department of the Board of Trade, the Dollar Exports Council (Board), the Federation of British Industries, the commercial banks, the Export Credits Guarantee Department, and from their trade association or export group. This is not an exhaustive list. The information provided by these organizations was no doubt less personal than that supplied by BETRO, but as far as background information on matters such as import regulations, tariffs, retail outlets, prices, etc., was concerned, these organisations appear to provide an excellent service. The Commercial Relations and Exports Department in particular, through its Special Register Service, available to all exporters at a nominal charge of 50*s.* annually, has provided exporters with really first-class reports prepared by overseas trade officials on the structure, organisation and trends of the market for a particular class of product in a particular country.

III. Conclusions.

It appears that one quite definite conclusion can be drawn from the foregoing analysis, namely, that the founders of BETRO greatly over-estimated the demand for overseas market research. This error in foresight was due not to factors which could not conceivably have been taken into account by them but rather to factors which could have been and should have been considered and assessed at the time. The result of this error was that BETRO was faced with the problem, not of meeting a given demand, but of *creating* that demand. This would not have been easy under any circumstances ; it was made more difficult by the fact that sellers' markets existed at

h ome and abroad and also by the fact that BETRO failed to establish itself in the favour of industry in general. Apart from the effect of the sellers' market—and it is not at all certain that this was an unmixed evil[1]—the fact that the actual demand for overseas market research would be small should have been foreseen by the founders of BETRO. It is impossible to resist drawing the conclusion that the reason for BETRO's failure lay in its fundamental design and was not due to outside, accidental factors, such as re-armament.

If it was thought essential to have a specialist overseas research organisation, then it should have been built up gradually ; and its expenditure kept to the absolute minimum. With a few first-class men, a more modest organisation could easily have operated quite successfully on an income of £40,000 a year and could have provided a very useful service to exporters. If a large-scale organisation was required, then it would have been wiser to have extended the scope of the organisation either to include domestic market research or to include other export activities beside market research. An organisation of either type might very well have been financially " viable ".

The decision to set up immediately a specialist overseas market research organisation on a large scale was, however, plainly ill-advised. And this conclusion is not merely a case of being wise after the event[2].

[1]*cf.* W. J. Thorne. *Banking*, 1948. " (BETRO's) aims are unexceptionable and its efficiency has already been proved, but it has to contend with one great difficulty at home. When there is a sellers' market, when everybody is willing to buy anything, exporters are inclined to grudge paying a subscription to an organisation designed to increase their range of possible customers—and when international trade slackens, we may be sure that many firms will promptly feel that they are unable to afford to contribute to investigations which cannot guarantee to bring them orders by return of post." (pp. 117-8).

[2]It may be argued that the founders of BETRO could not have known that the level of domestic expenditure in the post-war years was not going to be above £875,000. An inquiry into the present and future position of the domestic agencies even in 1945 would, however, have provided sufficient evidence. The founders and organisers of BETRO did not in their planning utilise the market research techniques which they recommended to others. This paradox is by no means uncommon amongst market research agencies !

It is difficult if not impossible, to discover why this decision was taken by the founders of BETRO; but the explanation is probably to be found in the social and political atmosphere which prevailed at the end of the war in which radical and ambitious solutions to all problems seemed both necessary and possible. In this atmosphere, the need for small beginnings—for pilot surveys and the like—tended to be either forgotten or despised. In this respect, BETRO may be put into the same unhappy category as the Overseas Food Corporation and other similar organisations.

Finally, since it has been claimed by Mr. G. de Freitas, M.P., that the disappearance of BETRO has left a serious gap in our export organisation, it should be pointed out that as far as general overseas surveys are concerned, British exporters are amply catered for by a number of organisations, including, since 1947, the Economist Intelligence Unit. The success of the E.I.U. suggests that BETRO was ill-advised to abandon this type of work: but it must be remembered that the E.I.U. has obvious advantages of prestige and goodwill which BETRO did not possess. In addition, unlike BETRO, it employs well-trained economists for this work. And as far as overseas sampling surveys are concerned, there are numerous British and foreign market research agencies that would be only too willing to carry out such research.

J. A. P. Treasure.

Cost-Output Variations in a Multiple Product Firm[1]

I. Introduction.

This article examines the cost-output relationships experienced in a multiple product firm. The firm selected for study was a medium sized, food-processing firm, producing directly for sale to the retail market. The period analysed was one of just over nine months from September, 1950, to June, 1951. During this time the firm was producing a " hard core " of about ten different products continually, while some other products were falling out of production and being replaced by new ones. As many products were perishable (within 2-3 days), much of the above production was in direct response to orders from the firm's retail outlets, and as these varied substantially from week to week there was considerable variation in individual output figures. An additional source of such variation was the fact that some raw materials were subject to seasonal changes in supply. The firm also produced certain standbye products (" fillers ") which were storable and whose ingredients were not subject to seasonal variation in supply. The output of these was varied so as to counterbalance the other output variations largely beyond the firm's control and thus maintain a fairly even flow of total activity. In addition to the above there was some production on special contracts, but the latter had to be ignored in our analysis as the " product " was by no means the same from contract to contract.

An elaborate and efficient accounting system produced weekly figures, showing among other things, (*a*) physical production of each type of product, and (*b*) total direct costs of each product sub-divided according to the four categories of Materials, Labour, Packing and Freight. The overall weekly allocation of indirect charges consisted of the cost of such items

[1] The author is indebted to the Trustees of the Houblon-Norman Fund for a research grant, which made possible the completion of this work, and also to the officials of the firm studied for their unfailing courtesy and helpfulness in providing statistical and other information.

as Salaries, Indirect Labour, Factory Charges, Laboratory Expenses, etc. These remained fairly constant over the period studied, and there was no attempt to allocate them between products, although arbitrary accounting rules exist for such allocation.

This accounting data made it possible to analyse the cost-output variations from two different angles. Firstly, it was possible to study the variations of direct cost with output for each product separately, and, secondly, to study the variation of Aggregate Direct Cost with variations in Total Output. Both analyses require the prior removal from the cost data of the influence of factor price changes, of which there were several in the period studied. It was possible to construct from the firm's records a factor price index number for each category of direct costs for each product and these were employed to deflate all four sets of cost figures, yielding a weekly total deflated direct cost figure for each product.

II. Cost-Output Relationships.

There are four main problems arising in the application of least-squares analysis to the estimation of economic relationships. These are :[1]

1. the continuity or serial correlation problem,
2. the confluence problem,
3. the problem of errors in variables,
4. the problem of errors in the equations.

The first problem arises because it is an assumption of the least-squares technique that the residuals in a regression equation are independent. The following analysis takes care of this point, and also throws some light on the applicability of the transformations suggested by Cochrane and Orcutt.[2]

Simple linear regressions of cost on output are found below to give satisfactory results, so that the confluence problem does not arise, there being only one independent variable in each

[1] See, *e.g.*, Richard Stone, *The Role of Measurement in Economics*, pp. 67-71.

[2] " Application of Least-Squares Regression to Relationships containing Auto-Correlated Error Terms." *Journal of the American Statistical Association*, 1949, pp. 32-61.

regression equation.[1] The third problem is most troublesome in aggregative analysis where most data are subject to large and often unpredictable errors. This is, however, not likely to be the case in the cost-output analysis of a single firm, if it possesses an efficient accounting system, and we accept here the accounting data as accurate records of the money costs and physical outputs in question.

The final assumption required for the direct application of least-squares methods to the derivation of the cost function is that output may be regarded as a pre-determined variable, from the firm's point of view. This would not normally be the case for a firm which actively adjusted its output level in the search for maximum profits. The profit maximisation condition would then constitute an additional restriction upon the output variable, which, if ignored by applying least-squares techniques directly to the cost function, would produce biased estimates of the parameters of that function. However, for the firm studied, output was largely a variable outside its direct control. This was the joint result of several factors. Being of medium size in an oligopolistic industry the firm was largely a price follower, so that it exercised little *direct* control over its price range. Moreover, demand was influenced by many other factors, which were to a great extent beyond the firm's control (*e.g.*, most demands displayed a pronounced seasonal variation). Thus at a given price, weekly sales are found to fluctuate widely, and the same spread of sales observations is often repeated when price moves to a different level. Finally, the perishable nature of most products meant that the weekly outputs were dictated almost completely by the weekly orders received from the retail outlets. For these reasons it seems permissible to estimate the cost function by direct application of least-squares methods, although the above assumption is not completely fulfilled.

Table I presents the regression analysis for each of the separate products produced during the period studied. The two variables for each product are Total Deflated Direct Cost and Output, both measured per week. All observations relate

[1]See, however, the section on cost inter-relationships, p. 147 below.

TABLE I.

REGRESSION ANALYSES FOR SEPARATE PRODUCTS.

Product (1)	Transformation (2)	No. of weeks (3)	Y= (4)	a (5)	bX (6)	r (7)	δ^2/s^2 (8)	C.V. % (9)
A	1	37	Y=	3·5	+0·1115X ±0·0022	0·9935	1·62	41
B	1	37	Y=	−5·9	+0·1620X ±0·0042	0·9884	1·61	34
C	1	36	Y=	181·6	+4·9293X ±0·2940	0·9445	2·67*	27
	$1+E^{-1}$	35	Y=	238·0	+5·1455X ±0·1942	0·9773	0·97‡	
	$1+0·3141E^{-1}$	35	Y=	183·3	+5·0722X ±0·2327	0·9670	1·79	
D	1	29	Y=	4·7	+0·4165X ±0·0251	0·9544	2·49	57
E	1	24	Y=	16·9	+3·6432X ±0·0454	0·9983	1·66	71
F	1	14	Y=	13·8	+3·4448X ±0·0957	0·9954	1·75	38
G	1	7	Y=	72·2	+4·0384X ±0·5111	0·9622	1·43	31
H	1	18	Y=	−31·5	+5·4472X ±0·1460	0·9943	1·29†	50
	$1-E^{-1}$	17	Y=	−0·7	+5·1324X ±0·1576	0·9930	2·57	
I	1	14	Y=	−90·6	+5·0368X ±0·2592	0·9845	2·60	21
J	1	20	Y=	8·4	+0·1192X ±0·0051	0·9842	1·71	53
K	1	17	Y=	−0·7	+0·0920X ±0·0019	0·9967	2·15	64
L	1	16	Y=	−16·2	+0·0687X ±0·0045	0·9709	2·36	23
M	1	20	Y=	168·1	+1·5711X ±0·1846	0·8950	1·22†	26
	$1-0·3774E^{-1}$	19	Y=	73·8	+1·8734X ±0·1138	0·8709	2·38	
N	1	9	Y=	1·2	+0·1111X ±0·0063	0·9889	2·15	69

Y = *Total Deflated Direct Cost.*
X = *Output.*
* *indicates significant negative serial correlation at the 5% level.*
† *indicates significant positive serial correlation at the 5% level.*
‡ *indicates significant positive serial correlation at the 1% level.*

to full working weeks so as to avoid the complications due to changes in the length of work period.[1]

For most products the output observations are scattered over a sufficiently wide range to justify the fitting of regression lines, the average coefficient of variation being 43 per cent. which compares fairly favourably with the averages of 45 per cent. and 55 per cent. for the two groups of firms in the author's previous study.[2]

From an inspection of the correlation coefficients and the illustrations in Graph I, it is seen that a simple linear regression gives an excellent fit in all cases.

Taking the 5 per cent. level as critical for either positive or negative serial correlation of the residuals, it is seen from the values of von Neumann's ratio in column (8) that 11 out of the 14 equations in terms of the original variables give residuals which are satisfactorily random. Of the three remaining values, one is indicative of negative serial correlation and the other two of positive serial correlation. In the case of negative serial correlation the first difference transformation is, of course, inappropriate. Let the regression be of the form :

$$Y_t = a + bX_t + u_t \tag{1}$$

where Y and X are variables in original units and u is the residual. Suppose

$$u_t = -\beta u_{t-1} + e_t \tag{2}$$

where e is a random residual. Then substituting for u_t in (1), we have

$$Y'_t = a' + bX'_t + e_t \tag{3}$$

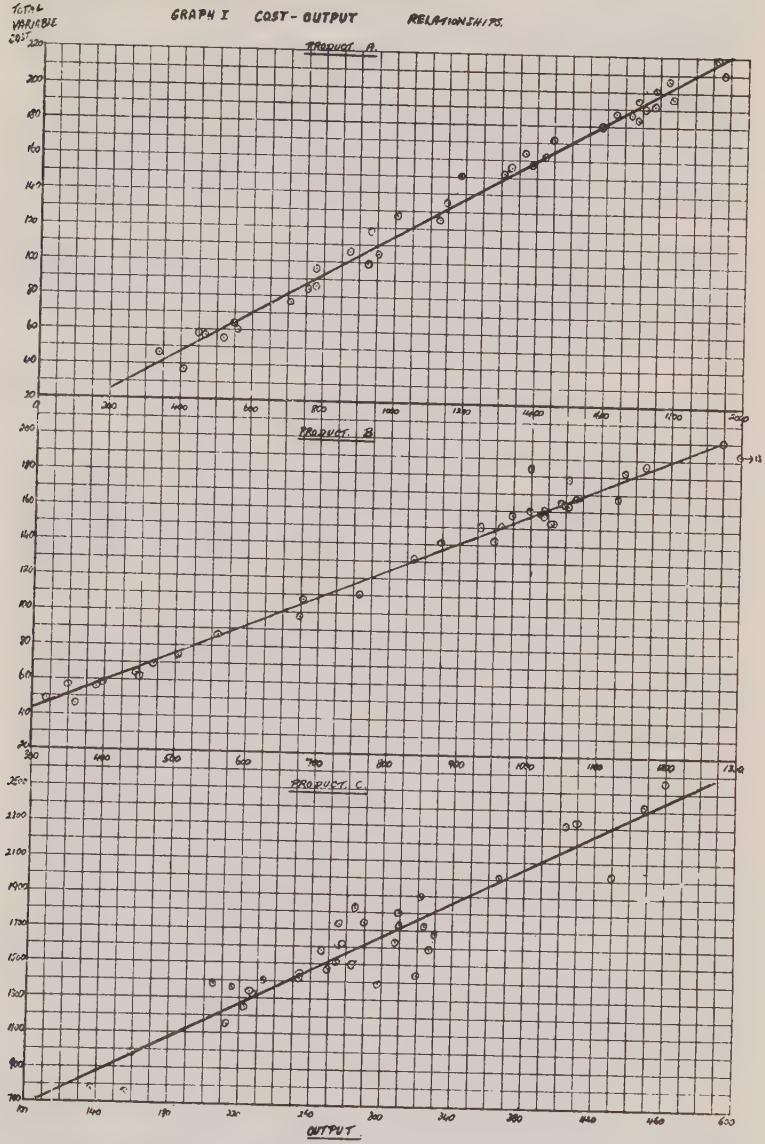
where the residual is random, and where

$$\begin{aligned} Y'_t &= Y_t + \beta Y_{t-1} \\ X'_t &= X_t + \beta X_{t-1} \end{aligned} \tag{4}$$

If we assume, as a first approximation, that $\beta = 1$, then the appropriate transformation of the variables as indicated by (4) is to sum successive pairs of values. This was tried for product C,

[1] *cf.* " Statistical Cost Functions in Electricity Supply." *Oxford Economic Papers*, Feb., 1952, p. 101.

[2] *Ibid.*, pp. 77-8. *Cf.* " Coefficients of variation greater than 30 per cent. are rarely encountered." *Statistics*, by Johnson and Tetley, vol. 1, p. 68.


GRAPH I COST - OUTPUT RELATIONSHIPS.
TOTAL VARIABLE COST
PRODUCT A.
PRODUCT B.
PRODUCT C.
OUTPUT

but the residuals of the transformed relationship were highly positively correlated.

A second approach was therefore tried, in which we attempted to estimate the autoregressive structure of the residuals in the original equation. This was done by computing the residuals (Z) from the original regression equation and estimating the parameters of the first lag difference equation

$$Z_{t+1} = \alpha - \beta Z_t$$

by least-squares methods. The value found for β was 0·3141, with a correlation coefficient of 0·3173, and a new autoregressive transformation was tried of the form :

(5) $$Y'_t = Y_t + 0{\cdot}3141\ Y_{t-1}$$
$$X'_t = X_t + 0{\cdot}3141\ X_{t-1}$$

This produced a regression with random residuals, ($\delta^2/s^2 = 1{\cdot}79$ which is fairly close to the expected value of 2·06 for a random series of this length). It is interesting to note that the correlation coefficient for the transformed series is actually higher than that for the original series, and that the difference between the two regression coefficients (5·0722—4·9293) is less than one standard error.

A similar stability of correlation, and to a lesser extent of regression, coefficients is found for the other two transformations (Products H and M). In the case of product H, a first difference transformation gives residuals which are satisfactorily random, and no attempt was made to estimate more precisely the autoregressive structure of the residuals. The correlation coefficients are 0·9943 (original) and 0·9930 (transformed), but this time the difference between the regression coefficients is equal to about two standard errors. For product M a first difference transformation produced residuals which were highly negatively correlated. The fitting of a first lag difference equation of the form, $Z_{t+1} = \alpha + \beta Z_t$, to the original residuals gave a value for β of 0·3774, with r = 0·3954, and so the autoregressive transformation

(6) $$Y'_t = Y_t - 0{\cdot}3774\ Y_{t-1}$$
$$X'_t = X_t - 0{\cdot}3774\ X_{t-1}$$

was tried. This gave satisfactory residuals, ($\delta^2/s^2 = 2{\cdot}38$ as compared with an expected value of 2·1 for a random series of

this length). The correlation coefficient was only slightly reduced, but the regression coefficient was significantly higher.

To summarise, the analysis of the joint variation of direct cost with output for each product considered separately, shows that in every case Total Direct Costs may be considered a linear function of output. Marginal cost is therefore constant over the observed range of output. Strictly speaking the average direct (variable) cost curve only coincides with the constant horizontal MC curve if the Total Direct Cost function passes through the origin. Where the intercept on the vertical axis is very small, the AVC curve quickly approaches the MC line asymptotically. Alternatively, the intercept of the y-axis, where positive, may be regarded as an element of fixed cost.

III. Cost Inter-Relationships.

When a firm is producing several different products simultaneously, the question arises whether, and to what extent, the production costs of any particular product may depend, not only on the concurrent output of that product, but also on the concurrent outputs of all other products.

The existence of such inter-relationships may be tested as follows. Let the outputs of the k products at time t be denoted by $X_{1t}, X_{2t}, \ldots, X_{kt}$, and the associated Total Variable Costs for each product by $Y_{1t}, Y_{2t}, \ldots, Y_{kt}$. Corresponding to each product we may define an Output Index, I_{st}, ($s = 1, 2, \ldots k$), which measures the output of the other k-1 products at time t. These Output Indices are of the base-weighted aggregative form with selling prices used as weights in the same way as for the output index for all k products. (See Section IV below).

The test for cost inter-relations is then to compute the partial correlation coefficient between Y_s and I_s with X_s held fixed, for each product, and test for significance. *A priori* one would probably expect $r_{YI.X}$ to have a positive value. For a completely satisfactory test we require to investigate for each of the products (1) the randomness, or otherwise, of the residuals from the multiple regression plane, and (2) the

confluence problem, since we have now introduced a second explanatory variable.

The results are presented in Table II. Considering the partial correlation coefficients shown in column (3), it is seen that six of the fourteen coefficients have negative signs, contrary to theoretical expectation. Of the eight positive coefficients three are significantly different from zero. In all, only four of the fourteen coefficients differ significantly from zero, three at the 5% level, and one at the 1% level. On this test the evidence is, in the main, against the hypothesis of cost interrelations. That is, in ten of the fourteen cases, the statistical explanation of the cost variation is not significantly improved by including an index of the concurrent outputs of the other products as a second explanatory variable. The firm was thus able to vary the outputs of individual products within very wide limits without significantly disturbing the constancy of average variable costs. This was mainly due to the general similarity of the processes used to produce the various products, the adaptability of the labour force and the flexibility of the equipment. An official of the firm indicated that it was strictly impossible to give a *single* and valid definition of the firms' capacity: it could only be defined in terms of the relative outputs of particular products or groups of products.

Columns (4) and (5) of Table II show that the conditions necessary for the application of significance tests to the partial correlation coefficients are in general fairly well satisfied. The residuals from the regression plane are significantly non-random in only four cases and then only at the 5 per cent. level and not at the 1 per cent. level. The correlation between the two explanatory variables is generally quite low, being numerically greater than 0·5 in only three cases.

IV. Variation of Aggregate Direct Cost with Aggregate Output.

Aggregation of the direct cost figures presents no difficulty since they are all in money terms. But heterogeneous outputs cannot be simply added together. A suitable method of aggregation may be found by noting that the most important

TABLE II.

COST INTER-RELATIONSHIPS.

Product (1)	No. of Observations (2)	$r_{Y1.X}$ (3)	δ^2/s^2 (4)	r_{1X} (5)
A	37	0·4033*	2·05	–0·5049
B	37	0·5058†	2·32	–0·1548
C	36	0·1232	2·50	–0·2224
D	29	0·2386	2·70*	–0·2235
E	24	–0·2076	1·98	–0·1350
F	14	–0·6797*	2·82	0·3545
G	7	–0·5641	1·54	–0·5428
H	18	0·5074*	1·84	0·3678
I	14	0·0372	3·24*	0·1014
J	20	–0·1114	1·81	0·2546
K	17	0·3010	2·49	0·0097
L	16	–0·3788	3·11*	–0·3958
M	20	0·4319	1·14*	0·4834
N	9	–0·4337	2·12	–0·5135

* *significant at the 5% level.*
† *significant at the 1% level.*

aspect of a product from the firm's point of view is its revenue producing capacity. When one product is substituted for another, the main consideration is the change in net revenue. Therefore we constructed an index of aggregate output by weighting the quantities by the initial selling prices of the various products, and summing over the products produced in each period. This latter series and the Aggregate Direct Cost figures were both expressed in index number form, so as not to reveal any confidential information, and the relationship between the two examined.

The coefficient of variation for the output index was 28%, so that there is a reasonable spread of observations. A simple linear regression of cost on output yields the following result,

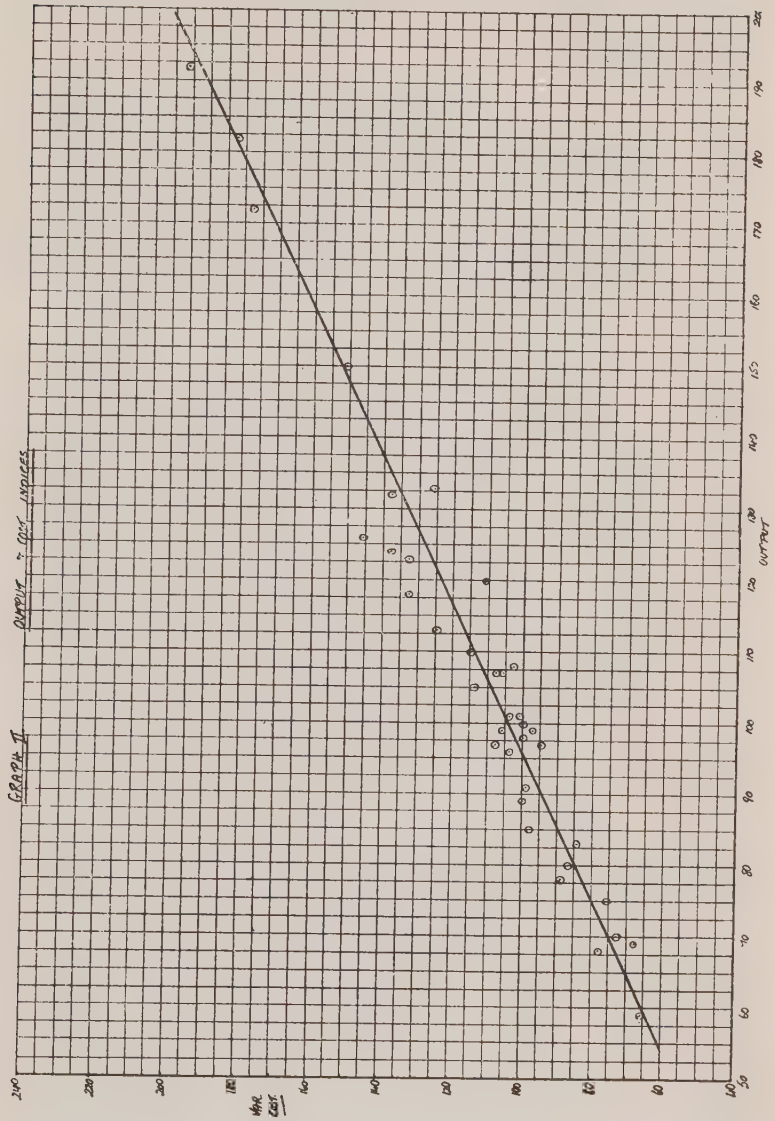
$$Y = 6 \cdot 1981 + 0 \cdot 9875 X$$

with r = 0·9783. This regression is shown on Graph II. The residuals, however, indicated significant positive serial correlation at the 1 per cent. level. The rough estimation of the autoregressive structure of the residuals from the original equation suggested the following transformation $(1 - 0 \cdot 4707 E^{-1})$. The resultant regression equation was,

$$Y' = 3 \cdot 2 + 0 \cdot 9913 X'$$

with r = 0·9686, and $\delta^2/s^2 = 2 \cdot 48$, ($N = 36$), which falls short of the 5 per cent. level of significance for negative serial correlation. As can be seen, the correlation coefficient in each case is very high, and the estimates of the regression slope very close together. The standard error of the estimate of the regression slope, calculated from the transformed data, is 0·0436, and the difference between the two estimates is much less than this.

It also follows from the calculated value of the standard error that the regression slope is not significantly different from unity. Since the intercept on the cost axis is very small, the approximate relationship between the cost and output indices is one of equality—a given percentage change in aggregate output (as measured by the index) tending to produce an almost equal percentage change in total direct costs. This also implies an equal percentage relationship between Gross Profits and Output. It is, however, unlikely that, in fact, Gross Profits could be indefinitely extended *pari passu* with output, for, while the regression function is a fairly good fit to the observed data, its prolonged extension in either direction is inadmissible. An extension upwards involves the implicit assumption that substantially higher levels of output can still be sold at the previous prices, since the fixed weights in the output index are product selling prices. This is unlikely to be true, and any attempt to sell greatly increased quantities at the same prices would probably lead to disproportionate


GRAPH II
OUTPUT & COST INDICES
OUTPUT
WAGE COST

increases in selling costs. If neither of these limits operate quickly, existing productive capacity would soon set a limit to aggregate output.

Another possible approach to the construction of the output index is to use average variable costs as weights. The resultant index makes possible a joint test of the constancy and independence of the average variable costs of the separate products. Let b_i, $(i = 1, 2 \ldots k)$ indicate the average variable cost for each product, as measured by the regression equations of Table I. Then the output index for period t becomes :

$$I_t = \sum_{i=1}^{k} b_{it} . X_{it}$$

This is, in fact, an estimate of what aggregate variable cost would be if average variable cost were constant for each product and independent of the outputs of the other products. Correlating the actual aggregate variable cost with this index should then give a correlation coefficient and a regression slope which both approach plus one the more perfectly the two assumptions are realised. The appropriate analysis gives $r = 0 \cdot 9699$ and $b = 0 \cdot 9407$. The standard error of b is $0 \cdot 0399$, so that the regression slope does not differ significantly from unity. Although the variable cost weights are not proportional to the price weights, owing to the variations in gross profit margins, yet the results of the two analyses are not dissimilar, and neither rejects the hypothesis of a regression slope of unity.

The statistical finding of constant and independent average variable costs for each product lends considerable indirect support to the basic hypotheses of the linear programming school, in so far as it is desired to apply those techniques to the theory of the firm.[1] Their definition of a productive " process " is equivalent to that of a linear, homogeneous production function with the supplementary condition that the inputs can only be varied *en bloc* by equal proportionate amounts. If we regard each product as being produced by a separate " process," then each has a linear

[1]See R. Dorfman. " Application of Linear Programming to the Theory of the Firm."

total variable cost function and this linearity also obtains for each category of variable cost (though the detailed evidence for this would take up too much space to include here). With constant factor prices linearity of cost functions implies linear, homogeneous production functions.

But our analysis relates only to the variable factors, and the core of the linear programming theory centres round the input matrix, which specifies the quantities of the *fixed* or *limited* factors required in order that each process be carried on at unit level.[1] The nature of these limited factors makes it very difficult to obtain similar statistical evidence for them, since these are the items, (land, buildings, machinery, tools, etc.) which are usually lumped under Factory or General Overheads and seldom allocated to specific units of output. Possible indicators such as floor-space occupied, machine hours, etc., might reasonably be expected to behave in a similar fashion to the variable inputs, but it seems doubtful if one of the limiting factors, namely entrepreneurial time and ability, has necessarily to be stepped up *pro rata* with increases in the level of a process. In general it would seem difficult to measure the intensity of use of most fixed factors by different processes at unit level, so as to provide the basic information required for the input matrix. On the other hand, some limited factors may not be fixed capital goods. In times of very full employment a firm may be unable to expand its labour force : under various forms of planning and control a firm may be allocated a specific amount of some scarce raw material or producer good—tinplate, steel, sugar, etc. These all become limited factors in the meaning of the linear programming analysis, which is then directly applicable.

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[1]See Dorfman, *op. cit.*, pp. 23-5 and 67-9.

The Industrial Structure of Towns

Towns can be regarded as economic units comparable in many respects with the regions and countries of which they are part. They can never be economically self-sufficient and to this extent they resemble countries which are dependent on foreign trade. This analogy suggests that the most important aspects of the industrial structure of a town are the size of its industry, the degree of self-sufficiency attained by it and the nature of its exports or its economic function.

It is desirable that the relationships between these aspects of the industrial structure of towns should be investigated by means of an empirical study of existing towns, but there are many difficulties arising from the defects of available statistics and the nature of the analysis required. The following discussion of the industrial structure of towns in England and Wales is based on an analysis of nearly 250 towns and conurbations ;[1] it illustrates both the difficulties and usefulness of such a study.

Since towns vary greatly amongst themselves, the analysis was made in two parts. The first part was designed to determine the extent of this variation and the most useful grouping of towns for the more detailed analysis of the second part. Some of the results are given in Tables 1 and 2.

The most suitable statistics for this purpose are those given in the 1931 Census Industry Tables. The fact that this Census was taken more than twenty years ago does not make such an analysis useless. Individual towns may have changed considerably in the intervening years but the general pattern of urban development, if one exists, can change only slowly and is probably the same now as it was in 1931.

A more serious difficulty arises from the fact that Census data relate to the enumerated populations of local authority areas, not to the resident populations of towns whose boundaries may not be the same. Part at least of the rural areas on the

[1]Unpublished M.A.(Com.) thesis, Manchester, 1948. The original analysis covered all C.B.'s, M.B.'s, and U.D.'s, with populations of 15,000 or more.

edge of growing towns should be regarded as urban ; the larger conurbations include many local authority areas and some urban districts consist of two or more urban centres rather than a single town. Also many people live in one district and work in another ; consequently the recorded industries for both workplaces and dormitories do not correspond to a group which has any actual existence. These difficulties were partly overcome by grouping together those areas known to have formed part of larger conurbations in 1931.[1] Also all districts with double names[2] and a few on the edge of the London conurbation were excluded from the analysis.

The size of a town's industry can be measured by the amount of employment it provides, and this can be related to the total population. It is also useful to distinguish between men's and women's employment ; on the whole these are not interchangeable and the migration of families is generally dependent on the chief male wage earner obtaining work. The ratios of occupied males to total population and occupied females to occupied males were therefore determined for all towns.

Discussion of the self-sufficiency of a town involves consideration of the relative importance of its local and basic industries.[3] These correspond to industries producing for the home market and for export in the country at large. Towns always require a supply of food and raw materials from outside and normally need a wide range of manufactured goods and services as well. All these must be paid for with the products of the basic industries. Mining and the majority of manufacturing industries come into this category. Local

[1]The thirty-seven main conurbations (populations 100,000 or more) in Great Britain in 1931 are described by Professor Fawcett in " Distribution of the Urban Population in Britain," *Geographical Journal*, February 1933. They are quoted in the *Minutes of Evidence to the Royal Commission on the Geographical Distribution of the Industrial Population.*

[2]For example, districts such as " Sittingbourne and Melton," whose name suggests two towns rather than one town.

[3]Professor J. H. Jones ; A Memorandum on the Location of Industry, Appendix II to the *Report of the Royal Commission on the Geographical Distribution of the Industrial Population.* Also see Industry and Planning in *Creative Demobilisation.*

industries provide services such as retail distribution, local government and transport which can only be provided in the locality. Some manufacturing industry such as printing and food processing which serves the needs of the town must also be regarded as local industry. It is clear that though some industries such as coalmining are always basic industries. there are many industries, particularly service industries which can belong to either group according to local circumstances. This means that it is not possible to distinguish between local and basic industries in terms of any industrial classification. The only practicable alternative is the distinction between service and non-service industry, and this alternative was adopted.

The analysis was made in terms of five main industry groups, agriculture, building, mining and manufacturing industry, service industries and the out of work. It was necessary to separate agriculture and building from the other industries since the size of the former is largely determined by the position of the town's boundaries, and the size of the latter mainly depends on the rate of growth of the town or nearby public works. Defence was included with mining and manufacturing industry and not with the service industries since it is invariably a basic industry. Unemployment was shown as a fifth industry group ; the wide variation in the incidence of unemployment at the time of the Census —4 to 43 per cent. among males for the towns analysed—made any other course impracticable.

A selection of the results is given in Table I. This shows all the relatively prosperous towns with populations between 25,000 and 60,000. The towns have been arranged in order according to the ratio[1] of their employment in service industries and in mining and manufacturing industries, though this ratio is not shown in the table. This arrangement tends to sort towns out according to economic function. The holiday resorts Margate, Eastbourne and Worthing are at one end of the table, and the specialised mining towns Bedlington and

[1] i.e., $\frac{\text{No employed in service industry (group 4).}}{\text{No employed in mining and manufacturing (group 3).}}$

TABLE I

TOWNS, POPULATIONS 25,000 to 60,000

	Total pop.	Occ. men as % tot. pop.	Occ. women as % occ. men	Proportion of persons in main industry groups (%'s)				
				1	2	3	4	5
Margate ...	31,341	28	65	2	6	10	73	9
Eastbourne ...	57,435	28	75	2	8	10	74	6
Worthing ...	46,224	26	66	7	9	10	69	5
Torquay ...	46,165	28	62	1	10	11	72	6
Folkestone ...	35,482	29	61	1	6	12	74	7
Weston-s-Mare	28,554	27	72	2	6	13	73	6
Harrogate ...	39,770	28	72	2	6	13	73	6
Tunbridge Wells	35,365	29	66	2	7	13	72	6
Woking ...	29,931	30	50	5	8	16	67	4
Cheltenham ...	49,418	28	66	3	7	16	65	9
Ramsgate ...	33,603	29	41	2	9	16	62	11
Salisbury ...	26,460	30	47	1	7	18	67	7
Shrewsbury ...	32,372	32	44	1	5	18	67	9
Guildford ...	30,754	33	45	1	7	23	64	5
Leamington ...	29,669	30	58	1	5	24	61	9
Chester... ...	41,440	33	46	2	5	25	58	10
Peterborough	43,551	34	34	2	5	27	56	10
Sutton Coldfield	29,928	31	53	3	7	28	58	4
Taunton ...	25,178	32	54	2	6	28	58	6
Bedford ...	40,554	31	50	1	5	30	56	8
St. Albans ...	28,624	33	50	2	7	30	55	6
Gravesend ...	35,495	34	32	1	5	32	52	10
Maidstone ...	42,880	32	42	2	7	34	51	6
Worcester ...	50,546	32	52	1	4	35	49	11
Colchester ...	48,701	35	36	3	4	39	48	6
Slough	33,530	36	35	3	9	36	42	10
Chelmsford ...	26,537	35	36	2	8	40	44	6
Wakefield ...	59,122	33	38	1	3	43	43	10
Lancaster ...	43,383	31	45	1	4	45	43	7
Stafford ...	29,485	33	43	1	4	47	40	8
Wycombe ...	27,988	37	32	1	5	55	34	5
Macclesfield ...	34,905	31	75	1	4	52	32	11
Kettering ...	31,220	35	50	1	2	59	32	6
Loughborough	26,945	34	50	1	6	54	28	11
Kidderminster	28,917	33	60	1	4	59	30	6
Nuneaton ...	46,291	35	44	1	4	58	26	11
Accrington ...	42,991	35	68	1	1	55	24	19
Aldershot ...	34,280	48	16	—	3	67	26	4
Cannock ...	34,585	36	17	1	4	66	23	6
Bedlington ...	27,461	35	12	2	2	65	22	9
Ashington ...	29,418	35	12	1	1	65	21	12
Ilkeston... ...	32,813	34	41	1	2	66	20	11
Rawtenstall ...	28,587	35	65	2	2	68	20	8
England & Wales		33	42	5	4	35	44	12

Notes on Table I.

Only relatively prosperous towns, *i.e.*, those with less than the national average amount of unemployment among men, have been included in this table.

The main industry groups are as follows :—

1. Agriculture. (Census Group II).
2. Building. (Census Group XIII).
3. Mining and Manufacturing industries, with which have been included fishing and defence. (Census Groups I, III-XII, XIV, and part of XVIII).
4. Service industries. (Census Groups XV-XXII less part of XVIII).
5. Out of work.

The towns have been arranged in order of the ratio of employment in service and mining and manufacturing industry, *i.e.*, group 4/group 3, though this ratio is not shown in the table.

Ashington are at the other. In between are the market towns such as Salisbury and Shrewsbury and the industrial towns such as Macclesfield, Kettering and Loughborough. But although there is a certain amount of regularity about the percentages in the table, there is no clear dividing line between the different types of town. The same result would have been obtained if the depressed towns had been included or if the table had been extended to cover both larger and smaller towns.

The relationship between industrial structure and economic function which is illustrated by these results has been used by several writers to provide statistical criteria for a functional classification of towns.[1] The towns are grouped according to the proportions engaged in various occupations or industries ; but such classifications are not entirely satisfactory. Either they involve an excessive number of groups or one or more of the groups is so heterogeneous as to be almost meaningless. The difficulty is that only some towns are single function towns ; many combine two or more functions. Consequently a completely comprehensive classification must allow for many combinations of functions. It is suggested therefore that a more useful approach to this problem would be to define the functions of towns and then to determine the typical structure of single function towns of these types. These could then be regarded as limiting cases for towns of mixed functions.

[1]Probably the most comprehensive of these classifications is that described by Chauncey D. Harris ; Classification of Cities in the U.S. Geographical Review, 1943.

For England and Wales the four main economic functions to be considered are those of resorts, market towns, transport towns and industrial towns. If industrial structure were only dependent on economic function, single function towns would form homogeneous groups which could be recognised by a detailed analysis of local manufacturing and service industries. This method was tried and a selection of the results is given in Table 2. It is necessary to define each single function town before attempting to isolate examples, since the names resort, market town, transport town and industrial town are generally used to describe towns in which these functions are predominant, but not the only functions.

The basic industries of the single-function resort are those catering for tourists and in so far as they draw their incomes from outside, retired persons and the dormitory population, if any, can be regarded as permanent visitors. For such a town it is impossible to distinguish between basic and local industries since they are of the same kind, *i.e.*, the service industries and the local manufacturing industries. The latter can be recognised from a detailed analysis; the most important in terms of employment are food, clothing, printing, the repair of vehicles[1] and drink.

For resorts the choice of towns for analysis was fairly easy, since only towns on the coast not known as ports had to be considered. Thirty-one such towns were analysed and they form a remarkably homogeneous group. For sixteen of these towns there was no evidence that they had any basic industry other than the holiday industries.

A single-function market town is a town which caters for the commercial, recreational and administrative needs of the surrounding area or region. The term can be used to describe small market towns, county towns, and regional centres in so far as they fulfill these needs and no others. As for resorts the basic industries will be mainly service industries, so that a test of the single-function market town is its lack of basic

[1]For local authority areas with populations less than 50,000 the Census classifications are Printing and Paper and the Construction and Repair of Vehicles.

manufacturing industry. A group of twenty-one inland towns which might qualify for this description were analysed.

The group of market towns was found to be much less homogeneous than the group of resorts. All except Cirencester and Spalding, both small towns with less than 15,000 population, had some manufacturing industry or defence which could only be regarded as basic industry. The single function market town would appear to be more limited in size than the single function resort. This is reasonable ; the size of both depends on the area served by the town and the intensity of demand for its services, but whereas the area served by a market town is limited, the resorts in competition with each other can and do cater for the whole country.

A single function transport town would be one whose basic industry was the transport of goods and passengers. It would resemble the resorts and market towns in that its non-service industry would be small, but transport would be relatively important among the service group. Only two towns were found to satisfy this definition. They were Harwich (12,000) and Newhaven (7,000). The larger ports and railway towns all have important industrial functions.

For a single function industrial town, the service industries would all be local industries ; the basic industries would be either mining or manufacturing industries. The industrial towns which form a homogeneous group are the highly specialised mining and textile towns of which Ashington and Rawtenstall are typical. All have a minimum of employment in the service industries, and all are fairly small. The largest, Ilkeston, has a population of 32,000. These towns certainly satisfy the definition of single function industrial towns, but it is doubtful whether they are the only single function industrial towns. Wellingborough, Macclesfield, Luton and many other towns are normally regarded as industrial towns but are not included in this group since they have a higher proportion of service industry. It may be that these towns also have some market town functions which account for their higher proportion of service industry ; or it may be that similarity of industrial

TABLE II

SINGLE-FUNCTION TOWNS.

	Occ. men as % total pop.	Occ. wmn. as % occ. men	Employment in mining and manufacturing industry (Group 3)			Employment in service industry. (Group 4)			
			Total	Food	Clothing	Total	Trans.	Dist.	Personal
Resorts.									
Hunstanton ...	26	89	9	1·9	1·8	78	4·0	15	39
Ilfracombe ...	27	63	9	1·5	1·7	71	6·6	16	31
Herne Bay ...	26	64	11	1·9	3·7	73	4·8	18	24
Bognor Regis ...	27	67	10	1·6	1·6	72	5·3	19	29
Llandudno ...	29	77	10	1·4	1·5	76	4·3	18	32
Clacton ...	27	62	10	1·2	2·0	71	4·3	18	32
Bexhill ...	24	87	9	1·3	1·8	74	3·4	15	35
Weston-s-Mare	27	72	13	1·8	2·8	73	5·5	19	27
Margate ...	28	65	10	2·7	1·5	73	5·3	18	29
Torquay ...	28	62	11	1·5	2·0	72	5·6	19	32
Worthing ...	26	66	10	1·6	1·9	69	4·0	18	28
Eastbourne ...	28	75	10	1·4	2·3	74	5·0	19	31
Hastings ...	27	65	10	1·7	2·3	73	6·4	19	26
Bournemouth ...	30	58	14	1·7	2·2	69	6·7	18	28
Market Towns.									
Cirencester ...	32	48	15	3·7	3·7	66	3·3	21	25
Spalding ...	32	42	12	3·0	1·8	46	5·2	18	12
Maidenhead ...	32	48	20	2·2	2·9	61	6·0	17	25
Hereford ...	32	47	20	2·9	2·0	63	8·1	20	17
Shrewsbury ...	32	44	18	1·5	2·0	67	16·5	19	16
Exeter ...	32	45	23	2·0	4·4	61	8·6	19	15
Transport Towns.									
Harwich ...	33	27	13	1·0	1·7	74	30·6	13	14
Newhaven ...	36	23	17	1·1	—	67	32·9	11	9
Industrial Towns.									
Hinckley ...	34	72	65	—	4·2	22	1·4	6	7
Hucknall ...	34	40	66	—	2·9	20	2·2	7	4
Bacup	35	65	67	—	26·6	17	2·2	6	3
Rawtenstall ...	35	65	68	1·6	22·3	20	2·0	6	4
Conisbrough ...	35	13	73	—	—	17	2·9	5	4
Brownhills ...	36	21	64	—	3·2	20	3·0	7	5
Abercarn ...	36	10	66	—	—	20	2·6	7	4
Ashington ...	35	12	65	—	—	21	2·1	9	4
England & Wales...	33	42	35	2·2	4·1	44	5·1	13	12

Notes on Table 2.

Resorts : the other towns for which this analysis was made were : Barmouth, Cromer, Ventnor, Skegness, Felixstowe, Paignton, Bridlington, Colwyn Bay, Weymouth, Morecambe, Ramsgate, Folkestone, Scarborough, Southend, Blackpool, and Brighton. These resorts, unlike those shown in the table, have a little basic industry which cannot be described as holiday industry.

Market towns : Spalding has 29 per cent. of persons engaged in Agriculture. Maidenhead has an electrical engineering industry (1·9 per cent) and a furniture industry (1·2 per cent.). In Shrewsbury 2·4 per cent. of persons are engaged in defence. In Exeter 2·4 per cent. are engaged in defence and there is a metal industry (3·0 per cent,).

The other towns considered were Downham Market, Bicester, Diss, Tewkesbury, Petersfield, Beaconsfield, Sleaford, Dorchester, Banbury, Salisbury, St. Albans, Chester, Maidstone, and Worcester.

Industrial towns : the other towns belonging to this group are Horwich, Mynyddislwyn, Washington, Hetton, Wombwell, Rawmarsh, Swadlincote, Adwick-le-Street, Heanor, Bedlington, Cannock and Ilkeston. The list would have been much longer but for the exclusion of towns with more than 13 per cent. unemployment among males.

structure is not a valid test for the single function industrial town.

For all towns it is reasonable to suppose that the ratio of basic to local industry is influenced by the wealth of the town, its size and rate of growth[1] and in the case of industrial towns changes in this ratio would also mean changes in the ratio of service to non-service industry. The wealth of an industrial town would be reflected in a higher proportion of service industries ; larger towns could afford a wider range of local industries than smaller ones. If a town expands rapidly as a consequence of the introduction of new factory industry it may be some time before the service industries adjust themselves to the change and meanwhile the town will have an abnormally low proportion of service industry. On the other hand in depressed towns, if non-service industry contracts further and more rapidly than service industry the ratio will be unduly high. It is necessary then to accept the second alternative, that single-function industrial towns do not necessarily form a homogeneous group. It follows then that an analysis of industrial statistics cannot be used to determine whether an industrial town also has market town functions.

These results may be summarised as follows. In England and Wales there are many single-function resorts and industrial towns. Single function resorts are characterised by a low ratio of occupied men to total population (28 per cent.) and a high proportion of employment in the service industries

[1]I think that the general problem involves more variables than is suggested by L. H. Klassen ; " The Economics of City Planning," *Econometrica*, April, 1952.

(70 per cent.).[1] Though it has not been possible to isolate all single function industrial towns, it is possible to conclude that for such towns the ratio of occupied men to total population is higher than average (35 per cent.) and that the proportion of employment in service industries is lower than average (minimum 20 per cent.). There are many market towns which though not strictly single function towns have very little basic manufacturing industry ; for such towns approximately 63 per cent. of occupied persons are engaged in service industries. Between the market towns and the specialised industrial towns there are many towns which combine these functions in differing proportions but this analysis cannot be used to estimate their relative importance. Single function transport towns rarely exist ; but towns with important transport functions tend to have a higher than average proportion of service industries and a higher than average ratio of occupied men to total population.

It may be objected that this analysis leads to no neater a conclusion than the functional classification of towns which was rejected earlier. This is true. Nevertheless the methods indicated here seem to provide a more useful approach to some of the economic problems of town planning.

This analysis of the industrial structure of towns has emphasised the differences between them. These differences are mainly due to differences in economic function, but are also partly due to other factors such as the uneven incidence of prosperity and unemployment and the lack of balance between male and female employment which existed in many towns in 1931. The first set of differences are fundamental and must be accepted by town planners ; the latter are not, and if regarded as socially undesirable the town planner can aim at reducing them.

The size of a town is ultimately dependent on the size of its basic industry. One condition for successful town planning must be the compatibility of industrial development, planned

[1]These typical values have been determined somewhat arbitrarily; they are averages for the groups analysed. They relate to conditions in 1931, and an up-to-date analysis, were one possible, might give rather different percentages.

or unplanned, and the plans for size and function of town. If a new town is to be developed as an industrially self-contained town of a particular size then the appropriate amount of industry must be allowed or attracted to it ; too much industry would result in either a larger town or to its becoming a workplace ; too little industry would result in failure of the town to grow or if the town were near enough to an expanding conurbation, in dormitory development. The problem of the town whose basic industry declines is similar ; the town planner needs to estimate how much new industry is required for it to regain its prosperity at the same or some other size.[1]

There is, however, no one formula which can be used to assess the industrial needs of all towns. In making such assessments the town planner must take into account the economic function or combination of functions of the town and try to maintain a suitable balance between local and basic industries and between male and female employment.

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[1]Compare *Town Planning*, 1943-51 (Cmd.8204), which states that " the location of industry is crucial to the proper planning of this country."

Profits in Large Scale Retailing[1]

The definition of "large scale" for the purpose of this study is the public company, important enough to be noted in *The Stock Exchange Year Book*. This covers the great majority of the large retailers in this country. It is therefore possible to get their annual reports and accounts and to compare trends in different lines of activity. It is recognised that there are many pitfalls to be avoided in working on accounts that are sometimes designed to satisfy the minimum requirements of the Companies Acts in force at the moment, but these are the only continuous records that we have over a long period of years. Recent turnover figures published by the Board of Trade do not carry us back very far, and they are based on a sample only of the trades covered.

The present investigation covers the largest firms that have been public companies since 1930, and an endeavour has been made to compare the trends in profitability of the different forms of retailing. However, different firms draw up their published profit and loss accounts (in reality the appropriation accounts) in a variety of ways, and (before the Companies Act of 1948), they do not always follow the same basis in different years. Therefore any conclusions drawn from these figures would be subject to a wide margin of error. What is certain is the capital of the firms and the dividends paid on that capital. The rate of return on capital represents the profitability of the business to the beneficial owners—which is one test of the profitability of different forms of retailing.

For each firm studied the return on issued capital has been calculated for each year. Where all the capital has been held in ordinary shares the actual rate per cent. is the figure taken. Where the capital is part ordinary and part preference the average return has been taken on the total capital. One

[1]Acknowledgements are made to the Trustees of the Houblon-Norman Fund for a grant towards the expenses of this research; to the Exchange Telegraph Company for the loan of statistical cards; to the many companies (the vast majority of those approached) who have supplied information in some form or another; and to *The Financial Times* for the use of its library.

COMPARISON OF TREND OF DIVIDENDS IN DEPARTMENT STORES AND MULTIPLE FIRMS.

1930 = 100

1	2 Dept. Stores	3 Boot and shoe	4 Men's clothing	5 Grocery smaller	6 Grocery Total	7 Catering
1930	100	100	100	100	100	100
1931	98	89	97	104	101	94
1932	88	88	92	104	100	90
1933	83	85	93	89	84	85
1934	86	91	118	84	83	86
1935	88	91	100	85	66	84
1936	89	96	116	88	67	87
1937	94	96	130	78	53	87
1938	95	92	131	73	51	81
1939	83	93	115	79	54	74
1940	79	91	108	88	51	73
1941	65	88	111	84	50	76
1942	70	91	97	87	54	85
1943	73	91	90	77	52	92
1944	82	91	108	78	53	96
1945	83	94	116	80	59	98
1946	100	107	152	87	63	116
1947	127	115	156	99	67	134
1948	121	116	157	99	67	137
1949	117	116	161	98	67	126
1950	114	119	166	94	69	125
1951	117	123	166	—	—	—

NOTES.

Department Stores. Based on seventeen separate firms, the majority of which operate more than one store. Several important firms had to be excluded, as in the period covered, owing to financial groupings and re-groupings, no continuous record is available.

Boot and shoe multiples. Based on ten firms, covering about 2,280 separate branches.

Men's clothing multiples. Based on eight firms.

Grocery multiples. Column 5 based on six firms ; column 6 based on eight firms, *i.e.*, the six plus the two large groupings.

Catering. Based on thirteen firms with catering interests, weighted, where known, in proportion to the firm's activities devoted to catering.

firm may have a capital of £1,000,000 in ordinary shares and pay a dividend of 10 per cent ; another with the same total capital may have half-a-million in 7 per cent. preference shares and half in ordinary shares ; if the dividend on the ordinary shares is 9 per cent., the average return on capital to the shareholders is 8 per cent. If as a result of losses the ordinary capital has been written down to £250,000, and a dividend of

10 per cent. is paid on this reduced capital, the real rate of return on the original ordinary capital is 5 per cent. and the average return on all capital would be 6 per cent. Similarly where the capital has been augmented by a bonus issue of, say, one share for every two held, and a dividend of 20 per cent. is paid on the increased capital, the real rate of return on the original capital is 30 per cent.

All results were then brought to a percentage of the dividend paid in 1930, and an average calculated for each trade group. The average figure is weighted by the total capital issued in each case. (Although an unweighted average of the returns on capital in each firm did not give significantly different results because of the tendency of dividends in the same trades to follow the same course. The only difference found was in the magnitude of the changes and not the direction). If an investor, or an investment trust, held shares in the seventeen department stores, both ordinary and preference in the same proportion as these shares were in issue, and if the return on capital in 1930 is taken as 100, then the return in 1950 would be 114, and similarly for the other groupings.

In general the trend of dividends represents the trend in profits earned in the different trades. For most of the years concerned the company chairmen have stated that an increased dividend was the result or increased earnings and that a reduction in the dividend was due to falling profits. Where there has been a general increase it has been because the trade has been expanding, and where the rate has fallen it is " because of the special difficulties and the fall in turnover ", etc.[1] The old established business (the vast majority in this survey) tends to relate its dividend policy to trading conditions. On the other hand the expanding firm tends to retain profits in the business and then to increase the rate of dividend when the position has been consolidated. Where this has been done it has usually been disclosed in the Annual Report. The index numbers of dividends would therefore tend to undervalue profits in the earlier years and to

[1]Copious quotations from the Annual Reports to prove this point would occupy far too much space.

overvalue them at the present day. It would hardly be significant for companies over fifty years old, the majority in this survey.

A further point is that since taxation has increased greatly the profits, before tax, have increased faster than dividends. But taxation affects all groups and the amount of tax will not affect the comparative position in different types of retail businesses. It does mean that there is less available for dividends and/or expansion and that the present rates of taxation must be taken into account when assessing the future prospects in different lines of retailing activity. But with the necessary caveats there has been sufficient variety of experience, depression, boom, war and post-war, to give an indication of the adaptability of different forms of retailing to changing economic circumstances.

Department Stores.

By 1930 all the firms covered in column 2 of the Table had had a long history. Many had been founded in the nineteenth century, and had had a rapid rise, soon attaining the status of large public companies. The period of their rapid expansion was over and they enjoyed an assured position in the market. Department stores in Britain probably did not progress so far or so fast as similar stores in Paris and in America, but if their progress was slower it probably was the sounder.[1] They had survived the difficulties of the first war and had been little harmed by the post-war depression. A number of important amalgamations had taken place just prior to 1930.

The falling trend in profits from 1930 during the Great Depression was less than that shown by corresponding American stores. Probably the efficiency of their management was never shown to better advantage than in the adaptability of the large department store to the change in the price level and the reduced spending power of their customers. A reading of the company reports of the period gives the impression of active managements solving new problems, and they were largely able to recover their trade down to the outbreak of the second

[1] I am indebted to Dr. Pasdermadjian of the International Association of Department Stores for this point.

war. The war-time averages conceal differences in the trading results generally; trade lost by the large London stores was gained by stores in the population reception areas. What is remarkable in the figures is the fact that trade did not decline more than it did, and many firms even recovered lost ground, in face of clothes rationing, absence of many commodities normally handled, the dispersal of their regular customers, and increased "austerity." Admittedly expenses were cut down, but the whole *raison d'être* of the department store had been to offer services and amenities, and it is a tribute to their reputation that they retained their customers when services were reduced. Happy is the business that can retain its custom in times of adversity !

The trend of profits is now settling down after the rise caused by the post-war restocking. Further, the results of individual stores are tending to diverge from each other. The large old established businesses tend to show a constancy of dividend, others a reduced rate compared with pre-war, while some, especially among the new firms, show better results than the immediate post-war years.

But even the maintenance of an average return on capital of 14 to 17 per cent. above the rates paid in 1930 is evidence of a comparative decline. Stores are reporting record turnovers in money terms, to maintain the same dividend, which represents a lower purchasing power. The net profit on turnover is lower, and the margin of operating error has been reduced.

The Multiple Shop.

Many observers believe that the rise of the multiple shop is threatening the position of the department store, and it is true that there has been a spectacular increase in the profits of certain multiple firms of recent years, often in fields where department stores have had a traditional market. (It is equally true that some department store groupings, by natural growth and by the acquisition of other stores, have produced rapidly expanding business units, and the process is still continuing). For a correct appraisal of the position it is necessary to make the same comparison with all forms of multiple trading and

not to contrast the virtual stability of department store earnings with those of new multiples in recent years. In many trades the origin of the multiple firm is as old as the department store. The same conditions towards the end of the nineteenth century gave rise to the development of both forms of organisation. Even where the present multiple firm may be much larger than when it was founded, by the opening of fresh branches, the larger unit should be showing a larger profit, if there is any expansionist tendency at work.

Boot and Shoe.

Manufacturing is generally conducted in moderately sized establishments and the largest firms in the industry are the multiple retailers, most of which own manufacturing plants. But as manufacturing is very specialised and the shops have to carry a great variety of stock it is the usual practice for the large manufacturer-retailer to buy in a large proportion of the goods sold through the chain of shops. The family business is characteristic ; sons and grandsons of the founders are to be found on the Boards of the public companies that have inherited the family businesses. Shares are generally held as an investment and not as a speculation. There is the same stability in management. While other chains have been absorbed, most of the expansion has come through the gradual founding of fresh branches. Expansion has not been pushed too far and the number of branches per firm is about 220. There is one large firm in this group, the result of an amalgamation, but the others seem to conform to the idea of a " representative firm."

The trading results of the sample of large firms with a continuous history since 1930 is given in column 3 of the table. Pre-war the results are similar to those of the department stores. (The exception in 1938 was caused by falling profits in one firm only). During the war in spite of civilian rationing good results were obtained because factories could be turned over to war contracts, although there were inadequate earnings on capital invested in shop premises. Since the war the figures have tended to rise, but not so high as the general price level.

But what the average figures do not disclose is the remarkable stability of the different firms in the industry. In two cases only is there the absence of an ordinary dividend when these firms were adapting themselves to the change in market conditions away from the heavier types of footwear to the lighter and more fashionable styles of the 'thirties. With many of the firms, under very different trading conditions, there is the same constant dividend, with a slight tendency to rise with increases in prices. Changes in the index are caused by changes in very few firms.

Furniture

In spite of the great increase in the output of furniture between 1924 and 1938[1] it has been impossible to prepare a comparative table of the trend in multiple furniture companies. Many fairly old businesses were converted into public companies after 1930, some of the most expanding only since 1946. The sample is further reduced by the amalgamation of many firms through the Great Universal Stores grouping so that their separate identity is lost. But a more important reason for not being able to produce representative figures is the great divergence of the results of the companies from each other. There is no general trend. Results are peculiar to the firms and are unrelated to the output of furniture, prosperity or depression. Nil dividends on ordinary shares and the temporary passing of preference dividends are extremely common. Out of 181 " dividend years " covering ten firms there were eighty-seven years in which no ordinary dividend was paid. Some firms apparently did well in depression years and badly in times of prosperity, while others show the opposite tendency. There is no evidence that the multiple furniture firm is gaining ground at the expense of the department store in times of rising prices, and it is probably more vulnerable in a depression as in many cases over fifty per cent. of the assets (at Balance Sheet valuations) are represented by debtors and goods on hire purchase. Although there are many stable firms, similar to those in the footwear industry, the industry as a whole gives an impression of great instability.

[1]From £17.8 millions in 1924 to £30 millions in 1938. Board of Trade Working Party Report. Furniture p.46.

Clothing—Men's.

There are here two types, the old established outfitting multiple business where the number of branches shows no tendency to increase and where the firms appear to have reached equilibrium, and the multiple tailor whose rise is much more recent. The industrial revolution began to affect clothing manufacture only by the beginning of the century, when the large multiples concentrate production in large factories and use their shops as purely retail outlets, thus introducing a greater degree of specialisation than is to be found in the bespoke tailoring shop. By their comparative cheapness they have largely created their own market.

Column 4 of the table requires some interpretation. Two of the firms are multiple tailors that have expanded rapidly during this period. In the early years their dividends were deliberately kept low to finance the extension of the firms and so do not reflect the actual profitability, and the higher dividends of the later period are a result of past ploughing back, and of the larger capital employed in the firms. Without these two firms there would be no rising figure for the period. Many of the outfitters show the same results in 1950 as they did in 1930 and inflation has left them behind the department stores and the boot and shoe firms.[1]

Clothing—Women's.

Here the trade is less standardised and the multiples have generally been concerned with specialities, such as furs, stockings, outerwear, etc., rather than with offering a more comprehensive range of goods. Out of nine large firms three only give continuous results. Two are just as profitable in 1950 as they were in 1930, one only has a record of expansion. Of the others one did so badly that it disappeared and was replaced by a firm of a similar name in such a way that it was impossible to calculate the rate of return on the original capital. One declined and became absorbed in another grouping. The other four became public companies just before the war, three

[1]The recent fall in textile prices badly hit the larger tailors owing to their large stocks and long-term contracts.

appear to be expanding their profitability. A number have become public in recent years and standardisation of the product through the utility scheme and clothes rationing have probably helped these firms to become established. But this type of business has been difficult to organise on a large scale and the firms have not been tested on a falling market with more individual buying.

Grocery.

The large multiple grocery firm developed at about the same time as the department store. In many cases the rise was spectacular and the successful entrepreneurs made considerable fortunes. But by 1930 this type of organisation seemed to have reached the peak of its development as dividend rates in the earlier periods were generally higher than in 1930. Even before that date the general rationalising movement of the late 'twenties had considerably reduced the number of public companies with an independent existence. (In addition there are a large number of moderate and large-sized businesses that are private companies, so that our conclusions do not necessarily apply to them).

Column 5 gives the results of six large firms, and column 6 of eight firms inclusive of the six. The total capital of the six firms is of the same order of magnitude as that of the two very large firms, so that if they were combined into one firm they would be nearly as big as the other two which have resulted from amalgamation. The six firms show a falling profitability even before the war in spite of an increased volume of trade and there was not the same recovery from the depression years as in other forms of retailing. The position was best maintained in the family grocer type of business. Many of the other firms had been built up on a " price basis " and their main appeal had been the cheapness of a standardised range of commodities. After the depression the price appeal lost part of its force, and customers turned to better, or dearer, commodities. The larger firms underwent a period of re-organisation to suit the changing market and many unprofitable branches were closed. They were badly hit during

the war because their main commodities were rationed, and customers preferred to register with less specialised grocers who were able to provide those other goods, which although unrationed, went to " regular " customers. Thus these firms have tended to broaden their scope by stocking a wider range of goods, often in premises designed to sell a limited range only. But on the whole in spite of the higher price levels few firms have paid higher dividends than in 1930 and the average dividend is well below that figure, and what is equally significant, the average rate is pulled down by the larger firms.

Catering

The thirteen firms in column 7 are important caterers although in many cases they have other interests of considerable importance, grocery, food manufacture, milk distribution, etc., and the purely catering firm is rare. In this case the comparative steadiness of the results is largely due to the dominance of the two largest firms with their very steady dividend record. The purely catering firms exhibit greater fluctuations than the others with wider interests. War-time rationing brought them greater trade and there is the tendency now to revert to the more difficult pre-war conditions. But in a trade in which casualties are frequent among the larger firms and in which there is always the competition of the customer providing his own facilities in times of difficulty, the results have surprisingly proved better than in what should be the more stable grocery trades.

The Variety Chain Store

A feature of the period covered has been the rise of a different type of retailer, that shares to a certain extent in the variety of the department store with the technique of branch shop operation, without the limited specialisation of the majority of multiples. The variety chain store may stock any goods within a selected price range, and those goods only which are frequently purchased. It may change its range according to economic conditions, and new lines may be tested in one or more stores. It therefore requires more

" management " than the ordinary multiple firm, but it is a field which seems to attract that special management ability. The circumstances of the times have been favourable with the greater equality of incomes adding to their potential market. Most of these firms have abandoned their previous fixed price policy and are moving into a higher price range (even allowing for the general increase in prices) but are very selective in the type of goods they handle. Other firms that have done well in recent years are multiple chemists, cycle dealers and hardware which, although they may have owed their origin to one particular trade, handle a great variety of commodities and are not bound to the fortunes of one particular line of goods ; they share in the characteristics of the department stores with multiple shop management.

Conclusions.

If this analysis is correct, it is not the multiple shop *per se* which is affecting the trade of the department store, but the retailer who is sharing in the characteristics of the department store and the multiple shop which is affecting the trade of both the older forms of organisation. While the latter on the whole show no expansion of profits, the more flexible variety type does not appear to have reached the limit of its expansion. It does not follow that the department store or the specialised branch shop will disappear ; but both, while retaining the same absolute size, may occupy a diminishing share of a larger market. The days of easy expansion are over and the future will depend on the flexibility of the management in relation to newer circumstances. The emphasis will be less on " trade " or " type " of firm and more on the function of merchandising. Department stores in the past have proved that they are adaptable to changing circumstances ; there is no reason to suppose that they have lost that art.

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Allocation and Programming in Modern Economics[1]

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Introduction.

This paper is concerned with the fundamental problem of normative economics, the optimum allocation of limited means towards desired ends. The field to be discussed is generally known as linear programming although other and more exact phraseology has been used. Thus activity analysis or the programming of inter-dependent activities do not connote linearity which is not an essential feature of the type of application for which the methods are suitable.

Applications in which activity analysis is appropriate are usually problems of the achievement of a given end at minimum cost or the maximisation of end-product at given cost. This would appear to be a straightforward case of maximisation or minimisation subject to a number of constraints to which the differential calculus with Lagrangian multipliers should apply. Here we see one reason for the emphasis on *linear* programming because it is, to some extent, the linearity in the system which prevents treatment by the normal methods of maximisation.

[1]This paper was read to the Manchester Statistical Society on 10th December, 1952.

The expression to be maximised or minimised and the constraints are usually linear functions which are not amenable to the processes of the differential calculus. Another hindrance is the fact that the constraints frequently consist of inequalities. The result is that the optimum position may not correspond at all to a stationary value of some function but be more akin to an extremity of a sloping ladder. The only way of handling a problem of this kind is really by systematic trial and error, a process which, in many applications, would be quite impossible without elaborate computing aids.

The origins of programming can be traced back to work of Austrian and German economists in the early 1930's.

Nevertheless, it is true to say that the techniques have been developed, almost entirely in the U.S.A., since 1939. Impetus was given to the development by the need to solve problems of logistics in the 1939-1945 war. The contrast with the conventional approach to economic problems is very apparent. Traditional treatment of a maximisation problem regards the equilibrium position as reached through a continuous movement towards equality of concepts such as marginal revenue and marginal cost which strictly have meaning only as derivatives of continuous functions. The productive process is regarded as permitting unrestricted variation in factor proportions. Indeed one necessary condition for equilibrium stability of an enterprise is continuously decreasing marginal rate of substitution of one factor for another.

In programming, on the other hand, specific restrictions are imposed on the proportions in which inputs are employed in any one productive process. No substitution between factors in a single process is permitted by the model and the inputs used are assumed limited in supply. In other words the analysis is essentially a short-period analysis. Indeed, one distinction between linear programming and the conventional marginal analysis can be regarded as the contrast between short-period and long-period analysis. This emphasizes the fact that linear programming does not replace the marginal analysis. Discontinuities in and non-differentiability of production, revenue, and cost functions do not vitiate the marginal analysis. It is

still possible to deduce equilibrium conditions although these will be in terms of finite inequalities rather than equalities involving infinitesimals. Then, however, derivation of such conclusions as that in equilibrium the price ratio between any two inputs must equal their marginal rate of substitution becomes impossible. The equilibrium conditions become little more than statements of truisms.

Realism is rather another matter. The lack of realism in the marginal analysis, the fact that these are not the kind of considerations in the minds of business-men, may be a serious drawback. On the other hand, the theory does not imply that business men achieve equilibrium through the conscious and deliberate satisfaction of derived equalities involving complicated economic concepts. All that the marginal theory says is that if entrepreneurs pursue the maximisation of their profits even though by means of a rather hit-and-miss process then certain relationships will necessarily hold true. However, though this may be so, the fact that linear programming does definitely accord with the business-man's approach and, particularly, with accounting practice would seem to be of considerable importance. The usefulness of the technique can be in no doubt since it has developed entirely in order to solve certain specific problems of a most practical nature.

Linear programming, then, is the term applied to the domain of problems involving the maximisation or minimisation of linear expressions subject to constraints in the form, usually, of linear inequalities. Discussion should begin, however, with an application in which no maximisation occurs ; a system in which there is one and only one way of reaching the end-point. This is the general equilibrium model of Professor Wassily Leontief, an approach with which has become associated the description input-output analysis.

LEONTIEF INPUT-OUTPUT ANALYSIS.

The central feature of the original Leontief scheme is the input-output table which exhibits the actual flow of commodities and services in the economic system from one sector to another. The number of sectors into which the economy can be divided

depends partly on availability of data and partly on the computing aids available for subsequent analysis. Sectors will be Households, Government, Foreign countries, and different industries grouped or sub-divided as necessary. Leontief tables for the American economy usually contain about 50 sectors. Barna's table for the United Kingdom in 1935 was divided into 41 sectors (10). Tables of this size are in the region where electronic computers or other elaborate and costly calculating mechanisms are needed. In the recent blue book (9) published by the Central Statistical Office on National Income and Expenditure 1946-1951 is presented for the first time an official input-output table for the United Kingdom. This relates to the year 1948 and includes 13 sectors. For purposes of exposition this has been still further summarised and is presented below in a form in which the eight industries of the original table have been grouped into three. Primary Industry consists of Agriculture and Mining. Tertiary Industry includes Building, and Electricity, Gas and Water.

INPUT-OUTPUT TABLE : UNITED KINGDOM, 1948

Sales by \ Purchases by	Primary Industry	Manufacturing Industry	Tertiary Industry	Final Buyers					£mn.
				Persons	Public Authorities	Gross Domestic Capital Formation		Export	Total Output
						Fixed	Stocks		
Primary Industry... ...	—	696	181	490	26	4	29	45	1,471
Manufacturing Industry ...	223	—	739	2,714	355	773	449	1,342	6,595
Tertiary Industry ...	164	856	—	3,253	1,292	602	32	481	6,680
Imports	72	1,121	218	590	122	35	—20	58	2,196
Incomes and depreciation	1,012	3,922	5,542	—	—	—	—	—	10,476
Net Indirect Taxes ...	—	—	—	1,345	33	52	5	32	1,467
Total Input	1,471	6,595	6,680	8,392	1,828	1,466	495	1,958	28,885

This table gives estimates for each sector of purchases for use in current production of goods and services and sales of final products. The figures along any row exhibit the distribution of output from the sector to which the row relates. They are the sums received from the sectors listed across the top of the table. Down any column are shown the inputs absorbed by the sector specified at the top. The figures are outlays incurred in purchasing goods and services (including labour) from the sectors specified on the left.

The data relate only to purchases and sales of goods and services. All financial transactions and all transfers between different sectors including overseas income and capital movements are excluded. Indirect taxes and subsidies are treated as though they were paid or received by final buyers. The value of the output of each industry is measured at factor cost and excludes that part of output used up in the industry itself.

The table, as it stands, represents a closed system. It is merely a description, after the event, of what actually happened in the British economy in 1948. In fact in this purely descriptive role the Leontief input-output table is merely a revival of the Tableau Economique of Quesnay. In order to appreciate the usefulness of possible applications of the input-output analysis it is necessary to consider the theoretical background to the scheme. This theoretical framework consists of three sections.

In the first place, there are equations expressing the fact that the total output of each sector equals the sum total of its products absorbed by other sectors. That is, the sum of all the items in each row must equal the total for that row, which is the total output of the corresponding sector.

Secondly, the total output of each sector equals the total value of all the goods and services absorbed by it. This means that for each industry the row total must equal the corresponding column total. The rest of the economy consisting of households, government, and overseas must be aggregated. We have incomes and depreciation which is gross domestic product plus stock appreciation equal to consumption, public and private, plus gross domestic capital formation plus exports minus imports, minus net indirect taxes.

Finally, the structural characteristics of the system are expressed by means of technical relationships between the physical output of a sector and the inputs absorbed in production. These structural relationships are the production functions for all the sectors in the economy. In fact, the most rigid and simple type of production function is adopted. Output of an industry is assumed proportional to each input. Thus the marginal product of each input is zero and returns to scale are everywhere constant. All factors are strictly complementary and technical substitutability within an industry is excluded.

The above formulation is, of course, the simplest version of the Leontief scheme. It is a static system in stationary equilibrium. Considerable work has, more recently, been done in dynamising the system by the introduction of stock-flow relationships complementary to the input-output scheme. These express the fact that output depends not only upon current input but on the time-accumulation of capital stocks. However the essential nature and usefulness of the Leontief model can be illustrated by the simple version described above. Most applications involve manipulation of the input-output relations as an open system. That is, one set of elements in the series of equations is left to be exogenously determined and the implications of assumptions made with regard to this set worked out.

For example, the items in the final buyers columns, which are usually referred to as the final bill of goods, could be fixed at any desired level. The resultant effect on the output and inter-transactions of the industrial sectors could then be determined. As an illustration of this procedure suppose the implications of assuming a uniform increase of 10 per cent. in exports while consumption and capital formation remain unchanged are worked out. This means that the input-output table takes the form

INPUT-OUTPUT TABLE : UNITED KINGDOM, 1948

Sales by \ Purchases by	Primary Industry	Manufacturing Industry	Tertiary Industry	Final Buyers: Persons	Final Buyers: Public Authorities	Final Buyers: Gross Domestic Capital Formation: Fixed	Final Buyers: Gross Domestic Capital Formation: Stocks	Export	Total Output
Primary Industry ...	—	x_1	x_2	490	26	4	29	50	X_p
Manufacturing Industry...	x_3	—	x_4	2,714	355	773	449	1,476	X_m
Tertiary Industry ...	x_5	x_6	—	3,253	1,292	602	32	529	X_t
Imports	x_7	x_8	x_9	590	122	35	—20	64	
Incomes and depreciation	x_{10}	x_{11}	x_{12}	—	—	—	—	—	
Net Indirect Taxes ...	—	—	—	1,345	33	52	5	35	
Total Input	X_p	X_m	X_t						

where the x's denote unknowns which are to be determined.

Equality of the total output of an industry and the sum total of its products absorbed by other sectors produces three equations.

$$\left.\begin{aligned} x_1 + x_2 + 599 &= X_p \\ x_3 + x_4 + 5767 &= X_m \\ x_5 + x_6 + 5708 &= X_t \end{aligned}\right\} \quad (1)$$

Next we have relationships between the x's regarded as inputs and the outputs of the corresponding industries. These are taken to be constant equal to 1948 values and as prices remain unchanged in our formulation, we have

$$\left.\begin{aligned} \frac{x_1}{X_m} &= \frac{696}{6595} = 0{\cdot}1055 & \frac{x_2}{X_t} &= \frac{181}{6680} = 0{\cdot}0271 \\ \frac{x_3}{X_p} &= \frac{223}{1471} = 0{\cdot}1516 & \frac{x_4}{X_t} &= \frac{739}{6680} = 0{\cdot}1106 \\ \frac{x_5}{X_p} &= \frac{164}{1471} = 0{\cdot}1115 & \frac{x_6}{X_m} &= \frac{856}{6595} = 0{\cdot}1298 \end{aligned}\right\} \quad (2)$$

Substitution in equations (1) gives

$$\begin{aligned} -X_p &+ 0{\cdot}1055\,X_m + 0{\cdot}0271\,X_t + 599 = 0 \\ 0{\cdot}1516\,X_p &- X_m + 0{\cdot}1106\,X_t + 5767 = 0 \\ 0{\cdot}1115\,X_p &+ 0{\cdot}1298\,X_m - X_t + 5708 = 0 \end{aligned}$$

Solving for X_p, X_m, and X_t we have

$$X_t = 6749 \qquad X_m = 6740 \qquad X_p = 1493$$

Substitution in the production functions (2) and the following analagous relationships for other x's.

$$\frac{x_7}{X_p} = \frac{72}{1471} = 0{\cdot}0489 \qquad \frac{x_8}{X_m} = \frac{1121}{6595} = 0{\cdot}1700$$

$$\frac{x_9}{X_t} = \frac{218}{6680} = 0{\cdot}0326 \qquad \frac{x_{10}}{X_p} = \frac{1012}{1471} = 0{\cdot}6880$$

$$\frac{x_{11}}{X_m} = \frac{3922}{6595} = 0{\cdot}5947 \qquad \frac{x_{12}}{X_t} = \frac{5542}{6680} = 0{\cdot}8296$$

provides solutions for all x's as follows

$$\begin{aligned} x_1 &= 711 & x_2 &= 183 \\ x_3 &= 226 & x_4 &= 746 \\ x_5 &= 166 & x_6 &= 875 \\ x_7 &= 73 & x_8 &= 1146 \\ x_9 &= 220 & x_{10} &= 1027 \\ x_{11} &= 4008 & x_{12} &= 5599 \end{aligned}$$

Writing these results in gives the input-output table shown on the next page. The output of primary industry increases by 1·5 per cent., of manufacturing industry by 2·2 per cent., and of tertiary industry by 1·0 per cent. Imports go up by 1·5 per cent. Incomes and depreciation increase by 1·5 per cent.

The only way these results could come about in this very simple model, prices being constant, would be by an increase of labour. In other words, this simple formulation implies that labour is the only scarce factor of production. A more realistic system would include stock-flow relationships as well as input-output equations. The implications of an increase in exports on capital stocks as well as labour could then be worked out.

INPUT-OUTPUT TABLE : UNITED KINGDOM, 1948

Sales by \ Purchases by	Primary Industry	Manufacturing Industry	Tertiary Industry	Final Buyers				Export	Total Output
				Persons	Public Authorities	Gross Domestic Capital Formation			
						Fixed	Stocks		
Primary Industry... ...	—	711	183	490	26	4	29	50	1,493
Manufacturing Industry ...	226	—	746	2,714	355	773	449	1,476	6,740
Tertiary Industry ...	166	875	—	3,253	1,292	602	32	529	6,749
Imports	73	1,146	220	590	122	35	—20	64	2,230
Incomes and depreciation	1,027	4,008	5,599	—	—	—	—	—	10,634
Net Indirect Taxes ...	—	—	—	1,345	33	52	5	35	1,470
Total Input	1,493	6,740	6,749	8,392	1,828	1,466	495	2,154	29,315

Furthermore, in the model considered above the assumptions made may have certain consequential implications on the working of the economic system which are not specifically stated. For example, a situation in which all home purchases remained unchanged while additional incomes were generated in expanding exports would imply acts of government policy in the shape of higher taxation and tighter control of investment.

It might have been expected that it would be possible to leave all compartments of the input-output table free to be determined and to calculate the effect of an increase in exports on consumption and investment as well as on industry. This is not possible, however, since there is only a single composite balancing equation for all the non-industrial sectors in aggregate and this is not independent of the balancing equations for the industrial groups. It would have been feasible to aggregate all the columns relating to home purchases and to introduce into the system an incomes/home purchases relationship. Then the increased consumption and investment consequent upon an

increase in incomes could have been worked out. This would have meant rises in the outputs of industrial sectors very much greater than those obtained in the above model. For instance, an assumption of constant proportionality between incomes and home purchases would imply an all-round ten per cent. increase in all outputs and incomes.

The answer to a question such as that posed in the above illustration is obtained as the solution of a set of simultaneous equations. If the number of industries is increased by further subdivision the number of equations increases and the position is rapidly reached when solution is only possible with the help of elaborate and costly computating aids. These will be discussed later.

Other examples of the type of problem to which the Leontief system provides the answer are, say, the effects of specifying a particular level of consumption or of capital formation. The importance of this type of analysis in relation to ensuring that government plans do not involve incompatibles needs no emphasis. The technique has received little attention from government departments in this country but in the United States a section of the Bureau of Labour Statistics devotes its attention entirely to input-output studies. The smooth turn-over from war to peace or the planning and undertaking of a re-armament programme are clearly types of problem in which important and significant contributions could be made by inter-sector analysis of the above type.

Another application is to trace the effect on the economy of prescribing particular levels of prices and wages. This is possible since, while the input-output table is usually expressed in value terms, conceptually the system is interpreted in physical terms. The two approaches are reconciled in the table as given by suitable choice of units. That is we can regard the figures as representing quantities such that one unit is purchaseable for £mn.1. That is, in ex-post input-output tables all prices are unity. The ratio-between any element in the table and the corresponding column total does then provide an estimate in appropriate units of a production coefficient. If now it is desired to determine the implications of assumptions

concerning prices care has to be observed since now prices will no longer be unity. Suppose q stands for the quantity of an input and p its price. Let Q be the quantity of an output and P its price. Then we shall have balancing equations of the type $\Sigma qp = QP$. These are easily converted into equations involving prices only by means of the production coefficients $c = q/Q$. Thus the problem will reduce to solving a set of simultaneous equations of the type $\Sigma cp = P$. Substituting the values of those prices exogeneously determined and solving for the rest will give all the prices in the economy.

The examples described above are all applications of the Leontief system in its simplest form. The important feature to notice is that always there is a unique solution. The ultimate end, be it a certain final bill of goods, level of prices, or system of wage-rates, is achievable in one and only one way. There are no alternative paths to the final objective. In consequence no maximisation or minimisation problems arise.

PROGRAMMING.

In contrast with the Leontief input-output analysis the terms activity analysis or the programming of inter-dependent activities usually do connote applications in which maximisation or minimisation is germane to the issue. Generally the desired end can be reached in different ways and the problem is to determine the most economical manner of attaining the objective. Alternatively the ways may be restricted and the question that of maximising the end. It frequently happens that points of contact between recent advanced developments in quite different fields are soon established and this has happened with programming. It was soon found that the technique had obvious similarities to processes in the theory of games, the novel approach to the study of economic behaviour by analogy with a game played under certain rules by a number of players adopting different strategies. Again, modern developments in the mathematical theory of point sets, particularly the properties of convex sets, have proved of great value in activity analysis. However in this paper it is intended to restrict discussion to the practical aspects of the programming

technique and the more theoretical considerations will only cursorily be touched upon.

Consideration will first be given to one or two applications of the programming technique. Then, its importance in relation to particular branches of economic theory will be discussed. The vast majority of applications so far have involved the maximisation or minimisation of linear expressions subject to a number of constraints in the form of linear equalities or inequalities. There has been, consequently, a tendency to refer to the subject as " linear programming".

Discussion should begin with what is generally recognised as the first application of the linear programming technique.

THE HITCHCOCK-KOOPMANS TRANSPORTATION PROBLEM.

Hitchcock (11) and Koopmans (12) independently considered the question of most economically shipping a homogeneous product from one set of original ports to another set of final ports. Suppose that originally the product is distributed in amounts a_1, a_2,.....a_m at m shipping origins. Finally the product is to be received in amounts b_1, b_2.....b_n at n shipping destinations. Let c_{ij} be the cost of shipping unit amount and x_{ij} the amount shipped from *i'th* origin to *j'th* destination. The problem is to minimise $\Sigma c_{ij}\ x_{ij}$ subject to certain constraints. These are that all the x's must be positive ; the total amount leaving the *i'th* origin must be equal to a_i ; the total amount received at the *j'th* destination must be b_j ; and finally, the sum of the a's equals the sum of the b's

Mathematically this means minimising $\underset{i,j}{\Sigma}\ c_{ij}\ x_{ij}$

subject to $x_{ij} \geq 0$

$$\sum_{j=1}^{n} x_{ij} = a_i$$

$$\sum_{i=1}^{m} x_{ij} = b_j$$

$$\sum_{i=1}^{m} a_i = \sum_{j=1}^{n} b_j$$

The c's being given constants the problem is the minimisation of a linear expression subject to a number of constraints in the form of linear equalities. In tabular form we have

TABLE OF SHIPMENTS

		Destinations				Totals
		1	2	. . . . .	n	
Origins	1	x_{11}	x_{12}	. . . . .	x_{1n}	a_1
	2	x_{21}	x_{22}	. . . . .	x_{2n}	a_2
	.	.	.		.	.
	.	.	.		.	.
	.	.	.		.	.
	.	.	.		.	.
	.	.	.		.	.
	m	x_{m1}	x_{m2}	. . . . .	x_{mn}	a_m
Totals		b_1	b_2	. . . . .	b_n	$T = \Sigma a = \Sigma b$

TABLE OF UNIT COSTS

		Destinations			
		1	2	. . . . .	n
Origins	1	c_{11}	c_{12}	. . . . .	c_{1n}
	2	c_{21}	c_{22}	. . . . .	c_{2n}
	.	.	.		.
	.	.	.		.
	.	.	.		.
	.	.	.		.
	.	.	.		.
	m	c_{m1}	c_{m2}	. . . . .	c_{mn}

Most of the constraints are already built into the tables. It only needs to be added that all x's must be positive. The problem is then to minimise $\underset{i,j}{\Sigma} c_{ij}\, x_{ij}$

A considerable amount of work has been done on the properties of matrices of the above kind, designed to ease the burden of computation which necessarily must be a process of

systematic trial and error. Iterative methods have been developed which are helpful if desk calculating machines are all that is available. However, if the numbers of origins and destinations are more than very small, electronic computers would be needed anyway and then short cuts or methods of successive approximation are superfluous. The electronic computer would arrive at the optimum by rapidly working through all possible solutions.

As an illustration of the method of solution suppose we take the following example :

TABLE OF UNIT COSTS

		Destinations				
		1	2	3	4	5
Origins	1	4	3	2	3	4
	2	6	5	4	0	2
	3	1	3	4	5	6

TABLE OF SHIPMENTS

		Destinations					
		1	2	3	4	5	Totals
Origins	1	x_{11}	x_{12}	x_{13}	x_{14}	$1-x_{11}-x_{12}-x_{13}-x_{14}$	1
	2	x_{21}	x_{22}	x_{23}	x_{24}	$5-x_{21}-x_{22}-x_{23}-x_{24}$	5
	3	$3-x_{11}-x_{21}$	$3-x_{12}-x_{22}$	$3-x_{13}-x_{23}$	$2-x_{14}-x_{24}$	$x_{11}+x_{12}+x_{13}+x_{14}+x_{21}+x_{22}+x_{23}+x_{24}-4$	7
Totals		3	3	3	2	2	13

Restrictions on the x's due to the requirement that no shipment shall be negative are as follows :

$$x_{11},\ x_{12},\ x_{13},\ x_{14},\ x_{21},\ x_{22},\ x_{23},\ x_{24}. \quad \geqslant 0$$
$$x_{11},\ x_{12},\ x_{13},\ x_{14} \quad \leqslant 1$$
$$x_{21},\ x_{22},\ x_{23} \quad \leqslant 3$$
$$x_{24} \quad \leqslant 2$$
$$(x_{11} + x_{21}),\ (x_{12} + x_{22}),\ (x_{13} + x_{23}) \quad \leqslant 3 \quad (x_{14} + x_{24}) \quad \leqslant 2$$
$$(x_{11} + x_{12} + x_{13} + x_{14}) \leqslant 1 \quad (x_{21} + x_{22} + x_{23} + x_{24}) \leqslant 5$$
$$4 \leqslant (x_{11} + x_{12} + x_{13} + x_{14} + x_{21} + x_{22} + x_{23} + x_{24}) \leqslant 6$$

Total cost, the sum of all products of shipment and unit cost, is found to be

$$24 + 5x_{11} + 2x_{12} + 9x_{21} + 6x_{22} + 4x_{23} - x_{24}$$

This is the function to be minimised. The crudest method of determining the optimum is to substitute in turn all values of the x's which would give a feasible solution and pick out the set minimising the cost function. A feasible solution is a set of x's satisfying the specified inequalities and the boundary conditions in the table of shipments. This would be, however, a laborious business as there are, in this case, 337 feasible solutions. Fortunately we can solve the problem much more rapidly. Leaving aside, for the moment, the question of feasibility, determine the lowest possible value of the cost function subject only to the upper and lower limits of individual x's. This will be attained when $x_{11} = x_{12} = x_{21} = x_{22} = x_{23} = 0$ and $x_{24} = 2$. Total cost will then be 22. Now take in *ascending order of magnitude* all possible variations of this total cost figure due to changes in the x's until the first (optimum) feasible solution is reached. The first variation will produce a figure of 23 when x_{11}, x_{12}, x_{21}, x_{22}, and x_{23} remain each equal to zero and x_{24} becomes one. This is still not a feasible solution. The next value on the (discontinuous) cost curve will be 24 which can be reached in either of two ways; if all the x's become zero, or, when $x_{12} = 1$ and $x_{24} = 2$ with the remaining x's still being zero. Again not feasible solutions. The next smallest possible increase in total cost is produced by x_{24} reverting to unity while x_{12} remains equal to one and the other x's zero. Total cost is then 25 and the solution is still not feasible. A total cost of 26 units can be reached in two ways. Either $x_{12} = 1$ with all other x's zero or $x_{23} = 1$ and $x_{24} = 2$

and remaining x's zero. The first alternative is not feasible but the second solution is feasible. The optimum table of shipments is therefore

DESTINATIONS

		1	2	3	4	5	Totals
Origins	1	0	0	1	0	0	1
	2	0	0	1	2	2	5
	3	3	3	1	0	0	7
Totals		3	3	3	2	2	13

Minimum total cost is then 26 units. It is noted that the inequalities imposed provide unique solutions for the x's which do not enter into the cost function, once the expression has been minimised.

The above is a very simple example. More realistic cases involving many ports and awkward data would probably not be so easy to solve by iterative methods. The importance of an analysis of this kind in times such as war when ships are likely to be a serious bottleneck and when the relevant decisions are taken by planning authorities such as a Combined Shipping Board, needs no emphasis. There are obvious peace-time applications too. A firm with several factories in different parts of the country supplying different markets is faced with a similar problem. The National Coal Board mining coal in different coalfields and distributing it to various markets would be expected to give some consideration to minimisation of transport costs. The fact, however, that there is price discrimination in different markets largely on the basis of transport costs may mean there is little incentive to tackle the issue.

An interesting application of linear programming which has recently been reported in the literature is in the blending of aviation petrol, due to Charnes, Cooper and Mellon (13). This is of particular significance because it would appear certain that many problems of this type constantly face multi-product firms in planning their production policies.

THE BLENDING OF AVIATION PETROL.

Aviation fuels are produced by blending basic refinery products and adding appropriate amounts of certain chemicals.

Different types of aviation spirit can be produced from given inputs in varying proportions. Residual amounts not used in producing aviation petrol can be used to blend motor spirit or diverted to other uses.

Each type of aviation spirit has to satisfy certain quality specifications of which the two most important are ignition properties and volatility. In addition policy and programming requirements in a refinery necessitate certain restrictions with regard to storage, etc., which imply limitations on the rate of consumption of the different inputs.

Introducing the appropriate set of prices for each of the types of petrol produced the problem is to maximise the net receipts function subject to the above requirements relating to technical qualities and policy restrictions. The only costs entering the net receipts function will be such variable items as cost of chemicals added, etc. Capital, labour, and cost of the basic refinery products used do not enter, as they can be regarded constant for all blends of output. Given the refinery and blending equipment even labour costs are largely determined, the blending activity having only an insignificant effect.

The net receipts function will clearly be a linear relationship involving the quantities of the different petrols produced. Prices are taken to be given constants. The constraints in the system consisting of technical quality requirements and policy restrictions can also be expressed in the form of linear equations or inequalities. The problem thus takes the familiar linear programming shape involving maximisation of a linear expression subject to a number of linear constraints.

Next we consider a situation which is of concern not only to business-men faced with similar questions but also to economists in their attempts to analyse the operations of individual enterprises. This is the warehousing problem considered by Cahn (14).

THE CAHN WAREHOUSE PROBLEM.

An entrepreneur is engaged in the buying and selling of goods, the production of which varies seasonally. There is consequently a seasonal variation in price. The entrepreneur has a warehouse of fixed capacity. He will aim to buy the goods when the price is low and sell them when the price is high. His ability to hold stocks is, however, limited by the capacity of his warehouse. Another limitations is that he cannot sell more than he has available at any time. Subject to these limitations it is assumed that he will attempt to maximise his profits. Putting this in mathematical form, suppose the year is divided up into n periods. These might be twelve monthly periods, for example, or fifty-two weeks.

Let p_i = cost price
p_i' = selling price
x_i = purchases
x_i' = sales
} in the i'th period

Let A = initial stock in warehouse at beginning of year.
B = capacity of warehouse.

Then stock in warehouse at end of i'th period.

$$= A + \sum_{i=1}^{i} (x_i - x_i')$$

Trading profit for the year $= \sum_{i=1}^{n} (p_i' x_i' - p_i x_i)$

This has to be maximised subject to

$$A + \sum_{i=1}^{i} (x_i - x_i') \not> B \text{ for any } i$$

and

$$x_i' \not> A + \sum_{i=1}^{i-1} (x_i - x_i') \text{ for any } i.$$

The first constraint expresses the fact that the stock at any time cannot exceed the capacity of the warehouse. Secondly, sales in period i cannot be greater than stock at the end of period (i-1).

A and B are known constants and the prices p_i, p_i' are taken as given. The problem is thus again, the maximisation of a linear expression subject to a number of linear inequalities. This time the functions involve the two sets of variables x_i and x_i'.

This application can easily be extended to cover more general cases. For example, limitations in the financial resources of the entrepreneur can be introduced. Indeed it is not exaggeration to assert that a general theory of the merchant could be formulated in linear programming terms. In fact, many of the cases of linear programming so far reported in the literature have been concerned with issues facing individual firms, farmers, managers, or organisations. It was, therefore, to be expected that the ideas inherent in the technique might be found to make significant contributions to the theory of the firm—the branch of economics concerned with equilibrium conditions of the individual enterprise. This has already proved to be the case. Robert Dorfman of the University of California can be said to have re-formulated and re-written the theory of the firm in programming language (15).

Linear Programming and the Theory of the Firm.

The conventional approach to the economic theory of the firm as represented, say, by Hicks (Value and Capital pp. 78-88 and 319-322) is in terms of the marginal analysis. A firm is supposed to be able to vary its inputs and outputs continuously in a quite unrestricted manner in maximising its net revenue. This maximisation of profits implies certain relationships which arise through equating first-order partial derivatives to zero and requiring second-order derivatives to be negative. These results are

(i) Price ratio between any two products must equal the marginal rate of substitution between them.

(ii) Price-ratio between any two inputs must equal their marginal rate of substitution.

(iii) Price-ratio between an input and an output must equal the marginal rate of transformation between them.

(iv) Marginal rate of transformation of input into output must be diminishing.

(v) Marginal rate of substitution of one product for another must be increasing.

(vi) Marginal rate of substitution of one input for another decreasing.

These relationships have meaning only as the result of algebraic and analytical techniques such as partial differentiation applied to continuous functions. In the case when production, cost, or revenue functions are discontinuous, results in quite this form cannot be deduced. This does not mean, however, that the equilibrium position for the firm is then indeterminate. It is still possible even in these circumstances to write down equilibrium conditions on the basis of profit maximisation. These, however, will involve finite incremental changes in the variables rather than infinitesimals. Thus, in themselves, discontinuities in production and cost functions due, say, to fixed production coefficients or to limitations on the use of certain inputs do not imply that the marginal approach must be completely discarded.

Moreover, in neither the continuous nor the discontinuous case does the theory necessarily imply that the business man actually in practice knows or calculates the values of complicated economic concepts and consciously preserves equalities or inequalities such as those above in pursuing maximum profit. The relationships are deduced as being true in the equilibrium position but they are not necessarily assumed to be actually and precisely the concepts which entrepreneurs have in mind in making their decisions. Profit maximisation in practice is likely to be much more of a trial-and-error or hit-and-miss process. This, however, again does not necessarily vitiate the conventional approach and theory.

The particular direction in which the new programming approach differs from convention is that instead of leaving the functions in the system general and unconstrained, specific assumptions are made *at the outset* to the effect that production coefficients are constant and that factors are limitational.

This leads to the problem facing the firm being expressible in programming terms and the whole approach becomes much more consistent with business and, particularly, accounting practice. Frequently there is inflexibility in the way inputs can be combined. When this is so it may be impossible to reach the optimum position specified by conventional theory. The highest position attainable on the net revenue curve may not be a stationary value of the function at all.

In the programming approach the structure of the firm is assumed to consist of a number of processes or activities in any one of which the inputs are always used in fixed constant proportions and the outputs produced, again, always in fixed proportions. Thus the only variation possible in a single process is that of scale. Processes can, of course, be used at different levels of scale and the problem is to choose the levels in such a way as to maximise net revenue subject to the constraints arising from the limitation of resources available.

Suppose s_i = scale of utilisation for i'th process.

Let w_j = remuneration per unit of j'th factor.

x_{ij} = utilisation of j'th factor in the i'th process when $s_i = 1$.

p_j = price per unit of j'th product.

y_{ij} = production of j'th product in i'th process when $s_i = 1$.

The net revenue of i'th process $= s_i \sum_j (p_j y_{ij} - w_j x_{ij})$.

Total net revenue for the firm $= \sum_i s_i \sum_j (p_j y_{ij} - w_j x_{ij})$.

x_{ij} and y_{ij} will be technical constants and if we consider the competitive firm, p_j and w_j will be market-determined independent of the production decisions of the firm. Total net revenue will hence be a function linear in the only variables, the s_i. The problem is to maximise total net revenue subject to the constraints.

$$s_i \not< 0$$

No process can be used at less than zero level, and

$$\sum s_i x_{ij} \not> A_j.$$

The j'th factor cannot be used to an extent beyond the total available.

Thus in the competitive case the problem reduces to the maximisation of a linear expression subject to $(i + j)$ linear inequalities.

If the firm were a monopolist then certainly p_j and, perhaps, to some extent, w_j, could no longer be regarded as constants independent of the level of output of the firm.

That is

$$p_j = F_1 \left\{ \sum_i s_i y_{ij} \right\}$$

and, possibly, $w_j = F_2 \left\{ \sum_i s_i x_{ij} \right\}$.

The expression for total net revenue would then no longer be linear. If, for example, the price of the j'th product and the remuneration of the j'th factor were linear functions of the level of output, that is,

$$p_j = a_j + b_j \sum_i s_i y_{ij}$$

$$w_j = \alpha_j + \beta_j \sum_i s_i x_{ij}$$

then total net revenue would be quadratic in the s_i and we should be in the realm of *quadratic* rather than *linear* programming.

It is seen that the contrast between programming and the marginal analysis is that the former is phrased throughout in realistic terms which correspond to the concepts with which business-men and accountants operate. The assumption of constant costs is certainly predominant, at any rate in the short run, in the realistic approach to accounting control. The lack of realism inherent in the marginal analysis is thus avoided.

On the other hand, perhaps the most serious criticism of the conventional theory of the firm applies equally well to the programming approach. This is that the fundamental basis of both methods is rationality on the part of entrepreneurs. The assumption that the dominating motive of individual enterprises is maximisation of profits is demonstrably untrue. Indeed, it is quite clear that there are many considerations

influencing every economic decision some of which are not even measurable.

We have now entered the realms of economic theory and it is appropriate to consider other applications of programming in this field.

Equilibrium in Spatially Separate Markets.

Consider the problem of equilibrium determination in the situation when a commodity (say, Wheat) is both consumed and produced in each of two or more spatially separated markets. Constant transport costs (shipping, insurance, duties, etc.), are assumed for carrying unit weight of the product between any two of the markets. What then will be the final competitive equilibrium of prices in all localities, of supply and demand in each market, and of imports and exports ?

The classical solution to this problem is trivial and simple. It can be stated in the following terms. The commodity will move from one market to another until prices (including transport charges) are equalised. There is clearly no maximisation or minimisation principle involved except in so far as the innumerable individual entrepreneurs involved in the transactions are all pursuing their private interests.

It is, however, as Professor Samuelson has shown, quite a simple matter to prove that the problem can be put into a normative form. Samuelson constructs a Net Social Pay-off function (N S P) which is, in fact, the algebraic sum over all markets of the gains through trade in consumers' and producers' surpluses less aggregate transport costs.

Samuelson (17) shows that equilibrium through price equalisation is achieved when the net social pay-off function is maximised. This maximisation has no significance from a welfare point of view. It is the exemplification *par excellence* of the " Hidden Hand". No competitor in the market will be aware of or concerned with N S P.

Now N S P is the algebraic sum of the gains through trade in consumers' and producers' surplus in all markets less aggregate transport costs involved in all movements. The gains in consumers' and producers' surplus clearly depend only

on the *total* imports and exports into and out of all the separate markets and not at all on any of the individual movements between pairs of markets. It obviously does not matter, in any one market, as far as consumers and producers surpluses there are concerned, where each bushel of wheat originated.

Hence if the total imports and exports into and out of each market are given then maximisation of the net social pay-off implies minimisation of aggregate transport costs.

A problem in which total imports and exports for each region are fixed and all the individual movements are to be determined such that transport costs are minimised is obviously precisely analogous to the Koopmans transportation problem, the classic instance of an application of linear programming technique. Thus the general problem of equilibrium in spatially separate markets contains within itself, as a special case, the Koopmans shipping application of linear programming. This is not only of importance in relation to the economic theory of the more general problem, the obvious significance of the fact that the equilibrium of spatially separate markets implies minimisation of transport costs. It is also of great importance to programming. It has been demonstrated that the minimum transport costs case can be solved as an unconstrained maximum problem. The significance of this is that Enke (24) has proved the latter solvable by electric analogue methods using relatively simple electric circuits. This is of considerable interest because of possible generalisation. If the appropriate general system could always be formulated so that any linear programming problem could be transformed into unconstrained maximisation, the gain would be enormous. So far it has always been assumed that any complicated linear programming application could only be solved by systematic trial and error using expensive electronic computers.

A situation analogous to the above is provided by the case of discriminating monopoly. The commodity is assumed non-transferable between markets so that price equalisation through the operations of arbitragers does not come about. The general problem is then the determination of the total output of the monopolist and the distribution of this product

among the different markets. This includes inside itself the less general case of optimum distribution of a *given* total output between different markets. There is, however, no linear programming application here. The problem is amenable to the normal methods of the differential calculus.

PROBLEMS OF COMPUTATION.

Linear programming applications all reduce to the maximisation or minimisation of a linear expression subject to a number of constraints. Even if these constraints are equalities the usual method of dealing with such a situation by means of partial differentiation and Lagrangian multipliers breaks down because of linearity in the expressions. A further barrier exists if the constraints are inequalities rather than equations, although an inequality can always be converted into an equality by introduction of an additional variable. Suitable transformations can also ensure that all variables are non-negative.

Generally, then, these problems can be solved only by systematic trial-and-error. In this process iterative methods, computing aids, and economising transformations are of obvious importance. The principal iterative procedure so far developed is the " Simplex " technique due to Dantzig (1).

THE SIMPLEX ITERATIVE METHOD.

Since any minimisation problem can be converted into one of maximisation, variables transformed so that all are non-negative and inequalities made into equalities a linear programming proposition can, with perfect generality, be expressed in the form.

To find $x_1, x_2, \ldots\ldots x_n$ maximising

$$c_1 x_1 + c_2 x_2 + \ldots\ldots + c_n x_n \qquad \ldots\ldots(1)$$

subject to $x_i \geqslant 0$ for all $i = 1, 2\ldots\ldots n$

and

$$\left.\begin{aligned} a_{11} x_1 + a_{12} x_2 + \ldots\ldots + a_{1n} x_n &= b_1 \\ a_{21} x_1 + a_{22} x_2 + \ldots\ldots + a_{2n} x_n &= b_2 \\ \ldots\ldots\ldots\ldots\ldots\ldots & \\ \ldots\ldots\ldots\ldots\ldots\ldots & \\ a_{m_1} x_1 + a_{m_2} x_2 + \ldots\ldots + a_{mn} x_n &= b_m \end{aligned}\right\} \ldots\ldots(2)$$

where the a's, b's, and c's are all constants.

Suppose each column of coefficients in (2) be taken to represent the co-ordinates of a point in m-dimensional Euclidean space. Let P_j be the j'th such point (co-ordinates being coefficients in the j'th column) and P_o the point represented by the constants b on the right-hand side.

The problem can then be said to involve

maximisation of $z = c_1 x_1 + c_2 x_2 + \ldots\ldots + c_n x_n \ldots\ldots (3)$.

Subject to $x_1 P_1 + x_2 P_2 + \ldots\ldots + x_n P_n = P_o \ldots\ldots (4)$.

A solution of (4) not necessarily maximising (3) is termed a feasible solution. A set of the x's which satisfy (4) and maximise (3) is a maximum feasible solution.

Firstly it is necessary to determine a feasible solution consisting of *exactly* m (the number of constraints) points P_i That is

$$x_1 P_1 + x_2 P_2 + \ldots\ldots + x_m P_m = P_o \qquad \ldots\ldots (5)$$

$$c_1 x_1 + c_2 x_2 + \ldots\ldots + c_m x_m = z_o \qquad \ldots\ldots (6)$$

$$x_i \geqslant 0.$$

Now express *all* points P_j in terms of a basis formed by the m points in the above feasible solution.

That is $P_j = x_{1j} P_1 + x_{2j} P_2 + \ldots\ldots + x_{mj} P_m \quad \ldots\ldots (7)$

$$(j = 1, 2 \ldots\ldots n)$$

and define z_j by

$$z_j = c_1 x_{1j} + c_2 x_{2j} + \ldots\ldots + c_m x_{mj} \qquad \ldots\ldots (8).$$

Now, several cases arise.

(i) If $x_{ij} \leqslant 0$ for all $i = 1, 2 \ldots\ldots m$, the maximum value of (1) is ∞.

(ii) If $c_j \leqslant z_j$ for all $j = 1, 2 \ldots\ldots n$, then (5) and (6) constitute a maximum feasible solution.

In neither of the above cases is the process of iteration continued. If, however,

(iii) $c_j > z_j$ for any j and, at least one $x_{ij} > 0$, the following procedure is adopted.

Multiply (7) by θ and subtract from (5)

$$(x_1 - \theta x_{1i}) P_1 + (x_2 - \theta x_{2j}) P_2 + \ldots\ldots + (x_m - \theta x_{mj}) P_m + \theta P_j = P_o \ldots\ldots (9).$$

Also subtracting $\theta \times$ (8) from (6)

$$(x_1 - \theta x_{1i}) c_1 + (x_2 - \theta x_{2i}) c_2 + \ldots\ldots + (x_m - \theta x_{mj}) c_m + \theta c_j = z_o + \theta (c_j - z_j) \ldots\ldots (10)$$

Now choose $\theta > 0$, as large as possible, so that all the coefficients in (9) and (10) are non-negative. This will mean that one coefficient will vanish. (9) and (10) will then represent a new feasible solution consisting still of m points but P_j will have replaced one of the original set $P_1, P_2, \ldots\ldots P_m$.

The value of z for this new feasible solution will be $z_o + \theta (c_j - z_j)$ and since $\theta > 0$, $c_j > z_j$ this must be greater than z_o. Hence we have arrived at a second and greater feasible solution. The whole process is now repeated continuously. The iteration will eventually terminate in a finite number of steps. At some stage either

$$x_{ij} \leqslant 0 \text{ for all } i = 1, 2\ldots\ldots m \text{ and fixed } j,$$

or, $c_j \leqslant z_j$ for all $j = 1, 2\ldots\ldots n$.

Then, cases (i) or (ii) come into operation and the problem is solved.

The steps in this process are illustrated by means of the following numerical example. It is required to find values of x_1, x_2, and x_3 maximising

$$x_1 + 2x_2 + 9\,x_3 = z \qquad \ldots\ldots(1)$$

subject to $x_i > 0 \quad i = 1, 2, 3$

and

$$\left.\begin{aligned} 2\,x_1 + 4\,x_2 + 16\,x_3 &= 10 \\ 3\,x_1 + 8\,x_2 + 30\,x_3 &= 19 \end{aligned}\right\} \qquad \ldots\ldots(2).$$

It is first necessary to determine a feasible solution consisting of two x's, say x_1 and x_2.

This is clearly $x_1 = 1\,;\ x_2 = 2$.

Now the coefficients of x_3 in (2) have to be expressed in terms of the coefficients of x_1 and x_2. Say

$$16 = 2\,x_{13} + 4\,x_{23}$$
$$30 = 3\,x_{13} + 8\,x_{23}$$
$$\therefore \quad x_{13} = 2 \quad \text{and} \quad x_{23} = 3.$$

It is noted that both x_{ij} 's are >0.

Next we have

$$z_3 = x_{13}\, c_1 + x_{23}\, c_2 = 2 + 6 = 8 < c_3 = 9.$$

Hence $c_j > z_j$ for $j = 3$ and iteration can proceed.

We write

$$(1 - 2\theta)\ P_1 + (2 - 3\theta)\ P_2 + \theta P_3 = P_0$$
$$(1 - 2\theta)\ 1 + (2 - 3\theta)\ 2 + 9\theta = 5 + \theta\ (9\text{–}8) = z.$$

All coefficients have to be non-negative.

Therefore, largest $\theta = \frac{1}{2}$. Then $z = 5\frac{1}{2}$.

The new feasible solution is $x_2 = x_3 = \frac{1}{2}$.

Now the whole process has to be repeated.

Firstly, the coefficients of x_1 in (2) have to be expressed in terms of the coefficients of x_2 and x_3. That is,

$$2 = 4\ x_{21} + 16\ x_{31}$$
$$3 = 8\ x_{21} + 30\ x_{31}$$
$$\therefore\ x_{21} = -1\tfrac{1}{2}\ ;\quad x_{31} = \tfrac{1}{2}$$

and, still, one $x_{ij} > 0$.

Next we have

$$z_1 = (-1\tfrac{1}{2})\ (2) + (\tfrac{1}{2})\ (9) = 1\tfrac{1}{2} > c_1 = 1$$

and $z_2 = 2 = c_2$

$z_3 = 9 = c_3$.

Hence $c_j \leqslant z_j$ for all j and $x_2 = x_3 = \frac{1}{2}$,
giving $z = 5\frac{1}{2}$, constitutes the maximum feasible solution.

This example has been worked through merely as an illustration of the " Simplex " method. It is, in fact, a very simple case. The maximum feasible solution could have been obtained much more directly as follows.

We have to maximise $x_1 + 2x_2 + 9x_3 = z$ subject to

$$x_i \geqslant 0$$

and $2\ x_1 + 4\ x_2 + 16\ x_3 = 10$

$3\ x_1 + 8\ x_2 + 30\ x_3 = 19.$

From the last two equations,

$$x_1 = 1 - 2\ x_3\ ;\qquad x_2 = 2 - 3x_3$$
$$\therefore\ z = 5 + x_3.$$

Now since $x_i \not< 0 \quad \therefore \quad x_3 \not> \frac{1}{2}$

$\therefore\ z_{max} = 5\frac{1}{2}$ as before.

The Simplex process was devised, of course, to be helpful in much more complicated applications, problems with many variables and many constraints. It must be remembered, however, that the essential feature of the scheme is determination of a feasible solution consisting of exactly m points where m equals the number of constraints. The single unique solution of a system of m simultaneous equations in m unknowns has consequently to be obtained. If m is large this is almost as difficult a task as the whole linear programming problem itself. A rather serious drawback.

It has already been seen that considerable benefit can be gained by converting a linear programming problem into a more general form. Transformation into an unconstrained maximisation allows advantage to be taken of methods developed for solution of the latter. The Koopmans transportation application being solvable as a special case of, the more general, spatially separated markets, can be dealt with by electrical analogue methods.

Another type of economising transformation which is of considerable importance is conversion of linear programming into theory of games.

Linear Programming and Theory of Games.

It is necessary, in the first place, to describe briefly the essential characteristics of the theory of games. We shall consider only zero-sum two-person games, that is, games between two players A and B such that, always, A's gain equals B's loss and vice-versa. Suppose there are three strategies open to each of A and B. The following table represents (say) A's gain (i.e. B's loss) in the game under these conditions:

		B's Strategy			Row minima
		1	2	3	
A's Strategy	1	—6	6	—7	—7
	2	—4	—5	7	—5
	3	0	4	5	0
Column maxima		0	6	7	

Any row minimum gives the greatest possible loss by A if he adopts that particular strategy. Similarly a column maximum represents the greatest possible loss incurred by B in adopting the corresponding strategy. A will then minimise his possible loss by choosing strategy 3, B by playing according to his strategy 1. Now, even if A knew that B was playing 1, he still could not do better than by playing 3. Similarly it would still pay B to play 1, even if he knew that A was playing 3. Thus the game is strictly determined. A unique stable solution exists. It does not pay either player to change his strategy even if he could find out the strategy of his opponent. The condition for this to happen is that the above pay-off matrix should have a saddle-point. That is, the lowest column maximum must equal the highest row minimum. In the above case both are equal to zero. Clearly, however, there is no reason why this condition should always be satisfied. Consider, for example, the following game :

		B's Strategy			Row minima
		1	2	3	
A's Strategy	1	—3	3	—4	—4
	2	—2	—2	4	—2
	3	2	0	2	0
Column maxima		2	3	4	

Here A minimises his possible loss by playing 3. But if B knew A were playing 3 it would pay him to play 2. Now if A knew B was on 2 it would be more profitable for A to play 1. And so on, indefinitely. Under these circumstances the game is not determined.

It is clear that in this type of game it is not much use a player attempting to discover his opponent's strategy. It is much more profitable for him to disguise his own intentions. One method of doing this would be to introduce an element of chance in the choice of strategy. For instance, a dice could

be thrown and the decision taken initially that if a 1 or 2 turns up, strategy 1 will be adopted : if a 3 or 4, strategy 2 ; and a 5 or 6 thrown by the dice would mean the choice of strategy 3. Generalised, this amounts to strategies being adopted according to pre-determined probabilities.

In these circumstances the picture of a player considering the different strategies and choosing that which minimises his possible loss is clearly inappropriate. The outcomes of a particular strategy have to be related to the probability of adopting that strategy. In this new approach it seems reasonable to assume that each player will minimise possible mathematical expectation of loss rather than the loss itself. The mathematical expectation of the game is the average value taken over the different strategies played according to the pre-determined probabilities. Thus suppose a_{ij} is A's gain when A adopts strategy i and B, his strategy j. Then if p_i is the probability of A playing i, and q_j the probability of B playing j, the mathematical expectation of A's gain is $\sum_{i\ j} a_{ij}\, p_i\, q_j$ where

$$\sum_i p_i = \sum_j q_j = 1.$$

Corresponding to any set of probabilities p_i for A and q_j for B, the mathematical expectation of A's gain can be worked out. Hence it will be possible to construct a matrix showing values of this expectation for all the different possible sets of p's and q's. A remarkable theorem in the theory of games states that this matrix must always possess a saddle point. The lowest column maximum equals the highest row minimum. The game is determined and a solution exists in the following sense. A set of probabilities p_i for A and q_j for B exists such that if A plays according to p_i and B to q_j, neither will have any incentive to change. Both players will simultaneously minimise their mathematical expectations of loss.

This remarkable result can be illustrated in the case of the following simple type of zero-sum two-person game. A and B each have two strategies at their disposal and the pay-off matrix for A's gain takes the form.

		B's Strategy		Row minima
		B_1	B_2	
A's Strategy	A_1	5	—3	—3
	A_2	—4	2	—4
Column maxima		5	2	

The highest row minimum not being equal to the lowest column maximum, the game cannot be determined if the players use " pure " strategies. Suppose, however, " mixed " strategies are adopted.

Let p_a = probability of A adopting A_1
p_b = ,, ,, B ,, B_1
Then
$1 - p_a$ = ,, ,, A ,, A_2
$1 - p_b$ = ,, ,, B ,, B_2
and

Mathematical expectation of A's gain $= 2 - 5p_a - 6p_b + 14p_ap_b$.

Row minima are therefore $2 - 5\ p_a$ if $p_a \geqslant 6/14$
and $9p_a - 4$ if $p_a < 6/14$.

$\therefore$ Maximum row minimum $= -1/7$ when $p_a = 6/14$.

Column maxima are $2 - 6p_b$ if $p_b \leqslant 5/14$
and $8p_b - 3$ if $p_b > 5/14$.

$\therefore$ Minimum column maximum $= -1/7$ when $p_b = 5/14$.

Hence highest row minimum is equal to lowest column maximum and a saddle point exists. A section of the matrix of expectations with values calculated for a few only of the possible probabilities demonstrates, but does not prove, the same result.

		p_b							Row minima
		0	.....	$^5/_{14}$	.....	$^1/_2$	.....	1	
p_a	0	2	...	$-^1/_7$	...	−1	...	−4	−4
	⋮	⋮		⋮		⋮		⋮	⋮
	$^6/_{14}$	$-^1/_7$	...	$-^1/_7$	...	$-^1/_7$	...	$-^1/_7$	$-^1/_7$
	⋮	⋮		⋮		⋮		⋮	⋮
	$^1/_2$	$-^1/_2$	...	$-^1/_7$	...	0	...	$^1/_2$	$-^1/_2$
	⋮	⋮		...		⋮		⋮	⋮
	1	−3	...	$-^1/_7$	...	1	...	5	−3
Column maxima		2	...	$-^1/_7$	...	1	...	5	

This type of game is formulated more generally, as follows an approach due to Dantzig (1) and Dorfman (1).

Suppose A has, at his disposal, strategies 1, 2..... n

and, B has, at his disposal, strategies 1, 2..... m

a_{ij} is A's gain when he plays i, and B, j.

The pay-off matrix will take the form.

$$\begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1m} \\ a_{21} & & & \vdots \\ \vdots & & & \\ a_{n_1} & & & a_{nm} \end{bmatrix}$$

A plays mixed strategies with probabilities x_i where $\sum_{i=1}^{n} x_i = 1$.

B plays mixed strategies with probabilities y_j where $\sum_{j=1}^{m} y_j = 1$.

$$\text{Then value of game} = y_1 (a_{11} x_1 + a_{21} x_2 + \ldots\ldots + a_{n_1} x_n) + y_2 (a_{12} x_1 + a_{22} x_2 + \ldots\ldots + a_{n_2} x_n) + \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots + y_m (a_{1m} x_1 + a_{2m} x_2 + \ldots\ldots + a_{nm} x_n)$$

$$\text{i.e. } \sum_{j=1}^{m} y_j (a_{1j} x_1 + a_{2j} x_2 + \ldots\ldots + a_{nj} x_n).$$

Now for any given set of x's (that is, along any row of the expectations matrix) the y's can take any values at all between 0 and 1 such that $\sum_{j=1}^{m} y_j = 1$.

Hence the row minimum will be achieved when all yj's are zero except the y associated with the smallest $(a_{1j} x_1 + a_{2j} x_2 + \ldots\ldots + a_{nj} x_n)$ in the above expression for the value of the game. This y will be unity.

Therefore, if A plays mixed strategies with given probabilities x_i, his expected pay-off will be

$$\text{minimum } (a_{1j} x_1 + a_{2j} x_2 + \ldots\ldots + a_{nj} x_n).$$

Thus A will choose his x's to maximise

$$\text{minimum } (a_{1j} x_1 + a_{2j} x_2 + \ldots\ldots + a_{nj} x_n).$$

Let L = minimum $(a_{1j} x_1 + a_{2j} x_2 + \ldots\ldots + a_{nj} x_n)$ for given x's.

Then

$$a_{11} x_1 + a_{21} x_2 + \ldots + a_{n_1} + x_n \geqslant L$$
$$a_{12} x_1 + a_{22} x_2 + \ldots\ldots + a_{n_2} x_n \geqslant L$$
$$\vdots$$
$$a_{1m} x_1 + a_{2m} x_2 + \ldots\ldots + a_{nm} x_n \geqslant L$$

Now introduce new variables d_j $(j = 1, 2\ldots\ldots m) \geqslant 0$ such that

$$a_{11} x_1 + a_{21} x_2 + \ldots\ldots + a_{n_1} x_n - d_1 = L$$
$$a_{12} x_1 + a_{22} x_2 + \ldots\ldots + a_{n_2} x_n - d_2 = L$$
$$\vdots$$
$$a_{1m} x_1 + a_{2m} x_2 + \ldots\ldots + a_{nm} x_n - d_m = L$$

Subtract the first equations of this set from each of the others

$$a_{11}\,x_1 + a_{21}\,x_2 + \ldots + a_{n_1}\,x_n - d_1 = L$$

$$\left.\begin{aligned}
&(a_{12}-a_{11})\,x_1 + (a_{22}-a_{21})\,x_2 + \ldots\ldots\ldots + (a_{n_2}-a_{n_1})\,x_n - (d_2-d_1) = 0\\
&\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\vdots\\
&(a_m-a_{11})\,x_1 + (a_{2m}-a_{21})\,x_2 + \ldots\ldots + (a_{nm}-a_{n_1})\,x_n - (d_m-d_1) = 0
\end{aligned}\right\}\text{(C)}$$

We also have $x_1 + x_2 + \ldots\ldots + x_n = 1$

where $d_j \geqslant 0 \quad ; \quad x_i \geqslant 0.$

Thus A has to choose x_i's satisfying (C) and maximising L. The zero-sum two-person game played under mixed strategies reduces, then, to the familiar linear programming problem of maximisation of a linear expression subject to a number of linear constraints. Conversely, a linear programming problem can always be formulated as a corresponding zero-sum two-person game. Formal equivalence of linear programming and the theory of games thus has been demonstrated. The question arises, what has been gained by this transformation ? The answer is that use can be made in linear programming of theorems worked out in the theory of games. In this way the burden of computation may be eased considerably. For example, in the pay-off matrix $\mid a_{ij} \mid$ of A's gain if each element in one column is not less than the corresponding element in another, the former column can be ignored completely. Quite irrespective of A's strategy, B could not be worse off by always perferring the strategy corresponding to the lesser or majorised column. Extending this result, if each element in one column is not less than the weighted average of any number of corresponding elements in other columns, again the greater or majorising column can be ignored. This amounts to saying that a mixed strategy exists, corresponding to the weights used in the above averaging, which is not inferior for B to a certain pure strategy, whatever A may do. Therefore the latter, the strategy corresponding to the majorising column, will never be used.

In linear programming, this means that any constraint can be disregarded, in which the coefficients are each uniformly not less than those corresponding in another constraint. Majorisation of one constraint by another implies that the latter is superfluous. Equally we need not consider a constraint in which the coefficients are each not less than the weighted averages of corresponding coefficients in other constraints. These economies clearly constitute a big gain. It was largely by their means that Morton (2) reduced the time of computation in one application from 120 to 15 man-days.

Finally, computing aids must be considered. In many cases transformation into an equivalent games-theory problem and use of an iterative procedure such as the Simplex technique makes the solution manageable in not unreasonable time using the desk-type calculating machine. This is important because these machines are the most commonly available and are now considered standard equipment for most large firms, organisations, government offices, etc. Even with fully-electric models such as the Madas, the Marchant or the Frieden, however, quick computation is so limited by the operation speed of the machine process that it is not feasible to contemplate solving a problem involving many variables and constraints in this way. Desk-type calculating machines are all of the type where multiplication and division are carried out by successive addition or subtraction. The numbers being handled are on revolving wheels or drums with cogged circumferences interlocking appropriately with cogs on the set of drums giving the result. One limitation is hence the speed with which such mechanisms can be rotated. Furthermore the machine cannot operate continuously, each individual calculation having to be set up and the answer tabulated separately. This still applies even when a series of similar calculations have to be carried out. While cumulative multiplication or the transfer of numbers from, say, the product register to the multiplier register usually present no difficulties, the possibilities of storage of information are severely limited. and results have to be recorded by hand. The setting up of the calculations and

recording of results are, in fact, the most time-consuming parts of the process.

The similarity of much of the computational work involved in solving a complicated programming problem naturally suggests adaptation of " Hollerith " type equipment to large-scale routine calculation (22). The equipment is well fitted to carry out repetitive computations of a similar kind. In addition the printing mechanism in the Hollerith machine reduces the time and trouble of recording results considerably. In this type of equipment information is recorded on cards by punching holes in appropriate spaces. Holes can be punched by an experienced operator at the rate of 10,000 to 12,000 an hour. The data are then fed into the machine by electrical means, the various mechanisms being actuated by electrical contacts made through the holes in the cards. The great advantages of the equipment are its flexibility and universality. Many processes which, with other types of computing aid have to be carried out by hand, are done at high speed automatically on the Hollerith. Thus data can be classified into groups by the Sorter at a rate of 24,000 cards an hour. The Tabulator prints the information to be found on a card or the results of calculations involving the data on a card, dealing with 3,600 to 9,000 cards per hour. The Multiplier will " read " numbers on a card and calculate pre-set functions of them at 600—1,800 per hour according to the number of digits. The Interpolator will collate data on two sets of cards. The Counter-Sorter counts frequencies in sub-groups. It is clear that for many types of large-scale computing work the Hollerith is the most suitable on grounds both of speed and economy. Furthermore, although the equipment may not be available in any but the larger organisations, the work can always be contracted out.

The need for very high speed in any computing device used in the large-scale routine calculations involved in trial-and-error methods reaches fulfilment in the employment of electronic circuits. In electronic calculating machines, which were first developed in U.S.A., during the war, numbers are

represented by chains of pulses passing through electrical circuits at electronic speed. The time of calculation is thus reduced enormously in comparison with any other type of machine. Numbers are expressed on the binary scale so that any one, consisting of a series of O's and 1's, is readily translated into a series of pulses. O is represented by the absence, 1 by the presence, of an electrical pulse. The passing of these pulse-chains through appropriate circuits performs the needed arithmetical processes. For example, on the binary scale, addition involves only the rules:

$$0 + 0 = 0$$
$$0 + 1 = 1 + 0 = 1$$
$$1 + 1 = 10.$$

Hence for the machine to perform addition it is only necessary to arrange that if a circuit is presented with pulses representing the two numbers on the left, it will emit a pulse representing the number on the right. Another great advantage of the electronic computers is that it has been found possible to incorporate elaborate and extensive storage mechanisms or " memories " which will hold chains of pulses representing numbers until they are required at a later stage in the calculations.

It is clear that the very great speed attained with electronic computers permits a scale of calculation not feasible without their aid. Solution of programming applications involving many variables and constraints is thus facilitated. There are, however, still difficulties. In the first place, this type of equipment is very expensive and is only likely ever to be available in a small number of centres. Secondly, while the time of actual computation is very much reduced the time taken in programming the machine to take a particular problem may still be prohibitive. Thirdly, the complicated nature of the mechanisms and circuits in the computer is likely always to involve a heavy incidence of breakdowns, very low load factors, and costly maintenance.

All the computing mechanisms considered so far have been digital machines. They all work with actual numbers directly in their digital form. It is necessary, finally, to discuss analogue machines or " instruments " as they have been called by Hartree (21). These translate numbers into physical quantities on some specified scale. The simplest example would be to arrange a circuit in which a current of x amperes flowed through a resistance of y ohms. Ohm's Law tells us that the potential difference across the resistance would be xy volts so that a voltmeter would give the product xy.

This is the basic principle of Enke's treatment, by electrical analogue methods, of spatially separated markets for a single homogeneous commodity (24).

Let P_i = price ruling in market i

E_i = exports from market i. Imports can be regarded negative exports.

Suppose E_i is a linear function of P_i say

$$E_i = k_i + b_i P_i \qquad \text{which can be written}$$
$$E_i = b_i (P_i - A_i)$$

A_i can then be interpreted as the price in i when $E_i = 0$.

Now goods move from market to market whenever a price difference emerges just as electricity passes whenever there is a difference in potential. Hence the movement of goods can be represented by flows of current in an electrical network, different points of which correspond to the different markets. The usual electricity convention that current passes from a point of high potential to one of low must, however, be reversed. Goods move from regions of low prices to markets where prices are high. With this modification the above relationship (1) can be considered analagous to the Ohm's Law equation.

$$\text{Current in Amps.} = \frac{1}{\text{Resistance in Ohms.}} \text{ (Potential Difference in volts).}$$

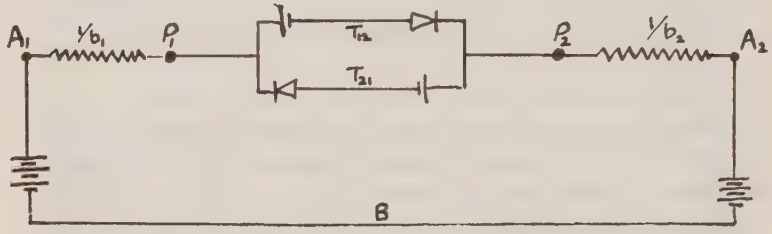
In the network, E_i, represented by a current, will be measured on a suitably calibrated ammeter, placed at an appropriate point, and $1/b_i$ will be a resistance. P_i and A_i being analogues of voltages, can be read off on voltmeters. The correspondence between electrical and economic units may be fixed at any reasonable ratio. The constants in the equations will be determined by incorporation into the system of existing knowledge. For example, suppose recent experience indicates that the change in E_i, consequent upon £1 change in P_i is 200 tons and that when the price is £100 per unit, 10,000 tons are exported. Then $b_i = 200$ and $A_i = 50$, so

$$E_i = 200\ (P_i - 50)$$

where E_i is measured in tons and P_i in £ per ton.

If now we fix £1 = 1 volt and 1,000 tons = 1 amp. then the resistance $1/b_i = 1/200$ in economic units (£ per ton^2), must be 5 ohms.

The electrical network for the simple 2-market case can be represented diagrammatically as follows :

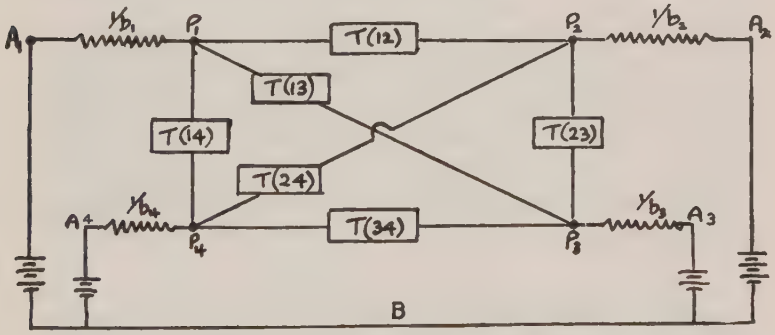


Batteries analagous to factories supply current (goods) to each of the points (markets) P_i. The system will move into stable equilibrium with current (goods) E_i flowing between P_1 and P_2.

The Potential difference across BA_i measures A_i, the price in i for which $E_i = 0$. The voltage across BP_i is the price P_i. Hence the *P.D.* across A_i P_i will be $(P_i - A_i)$

and as the resistance is $1/b_i$, the current E_i representing exports from i will equal b_i $(P_i - A_i)$. An ammeter placed between P_1 and P_2 will measure E_i. The fact that transportation is not a free service, means that a supplementary voltage, in a direction contrary to the flow of main current, corresponding in magnitude to transport costs per unit, has to be maintained between the two markets. Thus analagous to T_{12} we have a battery with +ve terminal towards 1 and a rectifier letting current through only in direction from 1 to 2. A similar arrangement applies for T_{21}. Suitably calibrated voltmeters placed across appropriate points measure T_{12} and T_{21}.

Circuits for cases involving more than two markets can be discussed in the same way. Following is Enke's diagram, simplified as regards the transport costs analogue, for a four-region network :



Here, however, current leaving P_1, say, divides between the three paths P_1 P_2, P_1 P_3 and P_1 P_4. The sum of the currents in the three paths must equal the current entering P_1 along A_1 P_1. Hence *total* exports from P_i will be measured on an ammeter placed in A_i P_i. Trade flowing between regions i and j will be given by the reading of an ammeter connected between points P_i and P_j. The direction of this trade will be opposite to the conventional current flow. Prices P_i in region i can be read off on voltmeters placed across BP_i.

It is seen that a simple electrical network can be constructed which will solve the several trading regions problem, given the trading functions for each region (the relationship between exports and price) and transportation costs. Ammeters and voltmeters, at and across appropriate points in the circuit, will indicate on suitable scales, the quantity of exports or imports flowing between any two regions and the prices ruling in each market.

It has already been seen that the general problem of spatially separated markets contains within itself the Koopmans transport application of linear programming. That is, if the net total of exports or imports out of and into each region are given the individual inter-regional flows are such that aggregate transport costs are minimised. The Koopmans problem is to determine these inter-regional flows. With the network the solution is simple. Potentials are adjusted until total exports from each market, measured on ammeters connected in $A_i\ P_i$, agree with the data of the Koopmans application. Then the individual flows measured on ammeters placed between pairs of points P_i and P_j provide the solution. These readings represent the inter-regional flows of goods aggregating to the given figures of total exports for each region and minimising aggregate transport costs.

Proof of this result by electrical analogy is neat and interesting. In stable equilibrium of the network P_1, P_2, P_3, P_4 the rate of heat production will be a minimum. That is, if R is the resistance, x the current, and V the potential difference along one of the members, $\Sigma R x^2$ will be minimised.

$$\therefore\ \Sigma\ x\ V = a \text{ minimum.}$$

But in our analogy $x = Q$ the quantity of goods flowing
and $V =$ transport costs per unit $= T$ (say).

Hence $\Sigma Q T =$ minimum, in stable equilibrium.

Thus aggregate transport costs are minimised.

The great advantage of the electrical analogue method described here is its relative cheapness. This is generally true of this type of instrument. It is therefore surprising that electrical analogues have not received more attention from economists. For instance, as long ago as 1933, Mallock (23) devised an electrical instrument for the solution of simultaneous linear algebraic equations. In the equipment as actually constructed at the time, 10 equations in 10 unknowns could be handled. No doubt the capacity could now be extended well beyond these limits if desired. The coefficients in the equations were represented by numbers of turns on various cores. The number could be set to any integral value from 0 to 100, with sign. The instrument was also adaptable to evaluation of linear forms and determinants and was well-suited to solution of the type of determinantal equation which frequently arises in the different forms of multivariate analysis.

There are many other types of analogue machine by no means all of them inexpensive. However, since they have not been reported as being used directly in connection with any important economic application it would be inappropriate to dwell on them here. There is one exception which should be briefly mentioned. This is a hydraulic analogue, namely the Phillips National Income machine (25, 26). This shows the quantitative changes which occur in an inter-related system of economic variables following initial changes in one or more of them. The analogy used is the representation of money by coloured liquid which flows around an income circuit consisting of perspex tubes.

The machine was not designed, however, primarily as a calculator. It was developed predominantly for teaching purposes. The accuracy claimed by the inventor is only $\pm$ 4 per cent. and that attainable in practice seems to be a good deal inferior to this figure. Furthermore, the system handled by the machine is a fully determined one and no maximisation or minimisation principle is involved either explicitly or by implication. The scope for this type of instrument in linear

programming seems therefore, to be somewhat limited. The hydraulic equipment can do little that an electrical system cannot carry out with greater accuracy and precision. The sole advantage is the visual possibilities of the machine in demonstrating, by analogy, the working of the economic system.

CONCLUSIONS.

To summarise, programming and particularly linear programming is a technique which arises in a surprisingly wide variety of economic problems. It is obviously of very great significance both to the economist, attempting to analyse how the system " ticks " and also to the business-man, pursuing his own interests. Unfortunately the approach usually involves a most intractable bit of mathematics—the maximisation of a linear expression subject to a number of linear constraints. Because of the impossibility of dealing with this by normal methods it is necessary to fall back on systematic trial and error. Economising transformations, iterative methods, and computing machinery are of great moment and value. There is considerable scope here for the economist, the pure mathematician, and the engineer.

Regrettably, co-operation between specialists is handicapped by the different languages they speak. It is certain that much obscurity of terminology is unnecessary. As a science develops it appears to erect around its boundaries a protective screen of mysticism and jargon which hinders rather than encourages co-operation and co-ordination with other fields of research. Linear programming is essentially a domain for joint effort. Indeed little progress could have been made in the past and little will be made in the future without such fruitful interchange of ideas.

Co-operation ought not to be confined merely to, say, the mathematical solution of economic problems. Theoretical developments in each province should be suggestive of new

approaches and problems in the other. There is clearly much of interest and importance to the economist, for example, in modern work on stochastic processes. D. G. Kendall's recent important paper (27) on the theory of queues, dealing with such topics as the formation of taxi-ranks in railway station yards or rows of customers in retail shops, is of vital concern to the economist but if he looks up that paper and reads the summary he is not likely to go very much farther. It is manifest that much is being lost by this state of affairs.

In conclusion, to make a concrete suggestion. It would be very helpful if entrepreneurs would come forward with problems which appear similar or analagous to some of those described in this paper. There must be many examples in, say, the distribution of a product from several sources or in the blending of inputs to produce a variety of outputs which would be amenable to treatment by programming methods. But the economist rarely finds himself in a factory and the business-man cannot be expected to keep in touch with recent advances in the field of economic theory. This Society provides an almost unique meeting-place to thrash out questions of this kind. Let us take advantage of and profit by such an opportunity.

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Wage Rates and Earnings in the Cotton Industry from 1946 to 1951

I.

Introduction.

One of the most striking features of wage movements in the United Kingdom during the war, and in the first five years after the war, was the divergence in the movement of wage rates and earnings. Between October, 1938 and October, 1950, wage rates in the industries covered by the Ministry of Labour's earnings enquiries increased by 77 per cent., and average earnings increased by 140 per cent.[1] This was an unusual phenomenon. The information for the inter-war years although neither detailed nor precise, suggests that rates and earnings moved closely together for that period.[2] It is also significant that the widening of the divergence stopped at the end of 1950, and in the last two and a half years there has, once more, been practically no difference in the proportionate changes in wage rates and earnings.

[1]The following table shows, at intervals since 1938, the changes in wage rates and in average earnings for all workers in the industries covered by the Ministry of Labour half-yearly enquiries.

	1938 = 100	
	Wage Rates	Average Earnings
1940, July	110—111	130
1945, July	143	180
1946, October	158	190
1947, October	161—162	203
1948, October	172	220
1949, October	175	229
1950, October	177	240
1951, October	196	265
1952, October	211	285

[2]See A. L. Bowley "*Wages, Earnings and Hours of Work*, 1914-47", London and Cambridge Economic Service, Special Memorandum, No. 50, May, 1947. He shows rates and earnings to have moved thus between 1924 and 1935 :—

	1924	1931	1935
Wage Rates ...	100	97	95
Earnings ...	100	98	100

The factors which may have accounted for the widening divergence in the years from 1939 to 1950 appear to be innumerable, but the following seem to be amongst those to which attention might be paid, in trying to discover the reasons for it. In the first place, wage rate indices are usually based on minimum national rates, agreed through collective bargaining, or laid down by statutory authorities, arbitration boards or other wage fixing bodies. They take no account, therefore, of local agreements or of payments above the minimum rates by particular employers, both of which are likely to lead in times of good trade to actual earnings increasing faster than the wage rate index. Secondly, a wage rate index measures the average change in rates which would occur if the distribution of workers between industries and between various categories of occupations within each industry remained unchanged. If workers move from industries with low earnings to those with relatively high earnings, or if there is a similar change in the proportions in different occupations or grades within industries, average earnings will increase even if there is no change in the wage rates of the particular industries, occupations, or grades. The significance of any such re-distribution as a contributory element to changes in earnings can be considered at various levels : a re-distribution between industries, between occupations within each industry, between grades within each occupation, between sexes, between adults and juveniles, or between skilled and unskilled workers. Thirdly, in those industries where there are piece rates or some form of payment by results, earnings may increase faster than rates because people work harder, or because production is more efficiently organised, or because improved machinery is introduced. Finally, since wage rates are measured for the standard normal working week, earnings may increase more than rates because of changes in overtime working. This may be important even if there is no change in the hours actually worked, because a reduction in the length of the normal working week would mean that a higher proportion of the hours was being paid at overtime rates.

While these four sets of factors are not meant to be a complete list of the causes of the divergence between wage

rates and earnings, it would be interesting if the contribution of each to the divergence between wage rates and average earnings in recent years could be measured. The answer to this problem is not without significance in discussing wage policy and in the economic analysis of wage movements, for arguments about wage policy and wage bargaining have perforce to be conducted in terms of wage rates ; it is in these terms that agreements can be fixed by law or arbitration. It is certainly true that the level of earnings influence what is said and done about wage rates, but it is difficult and unusual to attempt to fix earnings directly and to incorporate them into agreements. Unless we know, in some detail, how earnings and rates are related, an essential part of the complete picture is neglected in any arguments about wage movements and wage policy. This omission becomes especially serious, if the relation between movements of rates and earnings is not uniform for all industries, or for all grades and occupations within industries.

Unfortunately we cannot, with our present knowledge, measure the contribution of various factors to the divergence between wage rates and earnings with any confidence. The official wage rate index gives figures only for industry as a whole[1], thus making it impossible to compare the movement of rates and earnings in different industries. Figures of earnings for a large group of industries are now published regularly every six months by the Ministry of Labour, but these only give averages for each industry, or at most, for two or three separate sections of each industry. Such figures cannot be used to discover how far average earnings have increased because of changes in the distribution of labour between occupations and grades within industries, or because piece workers have gained more than those working on a time basis.

A detailed and conclusive analysis must therefore await the official collection and publication of more information

[1]The Ministry of Labour Wage Rate Index shows the percentage change, month by month, in the average level of full time weekly wage rates, using (since June, 1947) the approximate earnings bills in 1946 for weighting purposes. The index refers to the average movement for men, women, juveniles, and " all workers " in the industries covered by the Ministry of Labour statistics : no information is given for individual industries or occupations.

about wage rates and earnings. But it may be possible to throw some light on this problem by examining the position in particular industries for which additional information exists or can be collected.[1]

It was against this background that it was decided to examine in some detail the movements of wage rates and earnings in the cotton industry in recent years. The study set out to try to measure, and account for, the difference between the movement of rates and earnings in cotton spinning and cotton

[1]Such an analysis of rates and earnings has already been done for engineers, shipbuilders and dockworkers and the results have been published in the *Bulletin of the Oxford University Institute of Statistics*.

See Vol. 13, No. 6, 1951. "Earnings in Engineering, 1926-48," K. G. J. C. Knowles, D. J. Robertson.

Vol. 13, No. 7, 1951. "Some Notes on Engineering Earnings," K. G. J. C. Knowles, D. J. Robertson.

From the study of rates and earnings in engineering, it was concluded (No. 7, p. 225) that "between 1906 and 1948 rates have become a much less adequate guide to earnings; there has been a general decline in the skilled workers' relative earnings position (though different skilled groups have fared differently in this respect); the importance of semi-skilled work and of P. by R. [Payment by Results] has grown (although the relative earnings advantages of P. by R. workers have diminished and regional divergences in earnings have persisted)".

Vol. 13, Nos. 11 and 12, 1951. "Earnings in Shipbuilding," K. G. J. C. Knowles, D. J. Robertson.

In this study the analysis of rates and earnings showed that (p. 365), "As in engineering there are considerable differences between time rates and time workers' earnings, although the divergence between them has narrowed since the war".

Vol. 4, Nos. 9 and 10, 1952. "Dockworkers' Earnings," K. G. J. C. Knowles, Ann Romanis.

As a result of the analysis of dockworkers' earnings, it was concluded that (p. 361), "The national time rate . . . has very little influence on actual earnings especially since hardly any dockworkers are paid by time. Since variations in earnings may be due as much to changes in the composition of hours worked as to changes in the level of piece rates, and since there is no direct information on either, there is little relevance in comparing piece work earnings with the minimum time rate".

weaving since October, 1946[1]. This may be of interest not only for the light it throws on the general problems which have been discussed in the foregoing paragraphs, but also because it reveals important and significant changes in the cotton industry itself.

The summary of the results proceeds in four stages. Firstly, an explanation of the material available on wage rates in the cotton industry and of the construction of the wage rate index. Secondly, a description and analysis of the information on earnings. Here the main emphasis is on weaving, for which there are the detailed Wage Censuses taken by the Cotton Spinners' and Manufacturers' Association[2]. For cotton spinning, there are no such detailed regular censuses and we have to rely on the general figures in the Ministry of Labour's earnings enquiries. Thirdly, a comparison in detail between the movement of rates and earnings, to see how far we can explain the divergence between the two. Here again, because of the detail on earnings in weaving, we devote our attention mainly to that section. Finally, we sum up the main conclusions that result from the enquiry.

II.

Changes in Wage Rates.

The complexity of the wages systems in the cotton industry is well known. The wage systems, both in spinning and weaving,

[1]The analysis covers the period from October, 1946, to October, 1951. The only figures of earnings in separate occupations in spinning since 1938 refer to October, 1945. But we have not taken the analysis from this date as we wanted to compare the percentage increase in wage rates in spinning, directly with that in weaving. We could not have done this if we had taken October, 1945 as the base date, for the majority of the workers in cotton spinning had received an increase in rates at the beginning of that month, while the workers in weaving had to wait until February, 1946 for theirs. (An increase in rates in one section of the industry is either accompanied by, or soon followed by, an increase in the other section). We have taken October, 1946 as the base date because the Wage Census for occupations in weaving refers to that month. The analysis stops at October, 1951, because this is the date of the last Wage Census, and also because the background conditions which determine the rates of increase in earnings changed in the trade recession of 1952.

[2]We are very grateful to the Association, for having made the Wage Censuses available for use in this enquiry.

have their origins in the middle of the nineteenth century, and over the last hundred years have become increasingly complicated. Some attempt at simplification and standardisation has been made in the last few years, with " The Aronson Card and Ring Room Agreement, 1947 " and the " Evershed List " in spinning, and the " Cotton Manufacturing Commission " system in weaving. But numerous complexities still remain, and the calculation of changes in average rates for separate occupations, and for the industry as a whole, presents many intricate problems.

There are workers on time rates and piece rates in both spinning and weaving, and since 1946 increases in rates in both categories have sometimes taken the form of a flat rate increase of so many shillings a week, and sometimes a percentage increase on the basic time or piece rate. For time rate workers, percentage increases can be incorporated in an index without difficulty, and flat rate increases can be translated into a percentage increase in rates by relating them to the basic minimum rate in 1946. For piece rate workers, percentage increases can be treated in the same way, but flat rate increases cannot be related to a basic minimum weekly rate since there is no such rate for piece rate workers[1]. The only alternative is to express these increases as percentages of normal earnings in a base period. Here, we have used average earnings in 1946 as the basis for the calculations. Figures of average earnings were also needed to arrive at estimates of earnings bills for different occupations, to use as weights in combining the separate indices.

The basic information on rates, and changes in rates, was extracted from *Time Rates of Wages and Hours of Labour*, published annually since 1946 by H.M.S.O., and from the information on changes in rates of wages and hours of labour, given each month in the *Ministry of Labour Gazette*. These

[1]There is, it is true, a fall-back rate of weekly earnings for some categories of piece rate workers, but this is much below normal earnings, and is meant to come into operation only when earnings would otherwise be very low (because, for example, of short-time working). To relate the flat rate increases to this fall-back rate would give a misleading picture of the effective percentage increase in rates for workers.

were supplemented by special publications of organisations in the industry on wages and conditions of work[1]. In the case of piece rate workers where flat rate increases had to be related to 1946 normal average earnings to calculate a percentage change, information on earnings prepared for the Evershed Commission was used for spinning, and the 1946 Wage Census of the Cotton Spinners' and Manufacturers' Association was used for weaving.

It is not possible in an article of this kind to show in detail how the wage rate index was constructed, but some explanation of the occupations included in the index, and how information about rates was translated into percentage changes for separate occupations, is given in Appendix II to this article.

The increase in wage rates for each occupation included in the index, is shown in Appendix I, Tables I and II. The following table summarises the results for the main sections in spinning and weaving, and for significant groupings of occupations. Since there is no generally recognised division of occupations between time and piece rate, skilled, semi-skilled and unskilled, male, female and juvenile, the allocation of occupations to the various groupings has been in terms of the preponderant element in each occupation, and is therefore, to some extent arbitrary. A list of the occupations allocated to each grouping in spinning and in weaving is given in Appendix II.

In spinning, although there was a substantial variation in the increase in rates for particular occupations, the main groups moved fairly closely together and there is no significant difference in the movement for men, women and juveniles, for those on time and piece rate, or for those in skilled, semi-skilled or unskilled occupations. The increase in rates for cotton

[1]The most important of these were :
" The Aronson Card and Ring Room Agreement, 1947 " published by the Federation of Master Cotton Spinners' Associations Ltd., in December, 1947 ; the " Evershed List " published by the Amalgamated Association of Operative Cotton Spinners and Twiners, in December, 1948 ; " Joint Agreements on Wages and Conditions in the Cotton Manufacturing Industry " published by the Cotton Spinners' and Manufacturers' Association," May, 1951 ; " The Handbook of Agreements on Wages and Conditions " published by the Federation of Master Cotton Spinners' Associations Ltd., in October, 1951.

WAGE RATES IN COTTON SPINNING AND COTTON WEAVING FROM OCTOBER 1946 to OCTOBER 1951.
OCTOBER 1946=100

Cotton Spinning

	1948 January	1949 May	1951 January	1951 August
Total Cotton Spinning	114	120	132	139
Cotton Rooms	118	129	141	149
Blowing Rooms	111	118	130	137
Card Rooms	120	127	140	147
Ring Rooms	112	119	131	138
Mule Rooms	112	119	130	137
Winding Warehouse, etc. ...	110	116	127	134
Men	113	120	132	138
Women	115	120	132	139
Boys	111	116	128	135
Girls	110	119	131	137
Time Rate	114	121	133	139
Piece Rate...	115	120	132	139
Skilled	116	121	133	139
Semi-skilled	112	119	131	137
Unskilled	113	123	135	142

Cotton Weaving

	1948 February	1949 March	1951 January	1951 August
Total Cotton Weaving	109	114	126	133
Weavers	108	115	126	134
Ancillary Workers	109	114	125	132
Men	109	113	124	131
Women	108	115	128	134
Boys	115	119	131	139
Girls	112	115	127	133
Time Rate	112	118	129	136
Piece Rate	109	114	125	133
Skilled	105	109	119	125
Semi-skilled	109	115	127	135
Unskilled	115	121	133	140

weaving—33 per cent.—was about 6 per cent. less than in spinning over the period, and the disparity in the increases between various groups was more marked than in spinning. The much greater difference in cotton weaving between the rates for skilled, semi-skilled and unskilled is particularly noticeable.

For the cotton industry as a whole[1], the index shows an increase of 36 per cent. in wage rates between 1946 and 1951. This compares with an increase over the same period, of about 24 per cent. in the Ministry of Labour Index for all industries.

III.

Changes in Earnings.

The only earnings figures for cotton spinning during the period are those in the Ministry of Labour's half-yearly enquiries[2]. These give figures for men, women, boys and girls separately, but no detailed occupational analysis. The following table shows the change in average earnings for these four categories, in the first earnings enquiry after each change in the wage rate.

EARNINGS IN COTTON SPINNING
OCTOBER 1946 = 100

	1948 April	1949 October	1951 April	1951 October
Total	118	127	144	152
Men	117	125	141	149
Women	120	131	145	154
Boys	124	127	146	155
Girls	125	133	153	162

For weaving, there are the Ministry of Labour earnings enquiries and the five detailed Wage Censuses taken by the Cotton Spinners' and Manufacturers' Association in 1946, 1947, 1948, 1950 and 1951[3]. These Censuses were on a voluntary basis and the information returned at each date covered about

[1]The indices for spinning and weaving have been combined, using 1946 earnings bills as weights. The earnings bill for each section in October, 1946, has been estimated from average earnings, and total employment in that month.

[2]These are sample enquiries relating to the number of wage earners at work in the last pay week of April and October each year, to their aggregate earnings in that week, and to the total number of man-hours worked. Before October, 1948, figures were published only for the cotton industry as a whole. The Ministry of Labour has kindly provided the information for spinning and weaving separately from January, 1946 to April, 1948.

[3]For a more detailed account of these Censuses see Appendix III.

one-half of total employment in the weaving industry[1]. There is no way of discovering whether the figures of average earnings derived from these Censuses are representative either for particular occupations or for the industry as a whole. Elderly or disabled weavers were excluded from the figures and we have excluded throughout the earnings of certain ancillary workers for whom particulars were not collected until 1948. The Censuses do not cover exactly the same firms each time, but the great majority of the firms included have taken part in all five Censuses. Thus some part—although probably only a very small part—of the changes in average earnings and in the distribution of the labour force may be due to variations in the composition of the firms covered by the Censuses. While these omissions and qualifications must be kept in mind when we come to compare the movement of earnings and rates, the Manufacturers' Censuses are of great value, in that they give separate earnings figures for eighteen ancillary occupations in weaving, for weavers on six different loom systems and, within each loom system, an analysis by ranges of earnings.

The Manufacturers' Censuses do not distinguish between male and female earnings, and only a small number of the juveniles in the ancillary section are shown separately—and then only for the last few Censuses. But the Ministry of Labour enquiries give earnings separately in each of these categories, and the changes which they show over this period are summarised below. The more detailed figures derived from the Manufacturers' Censuses are given in Appendix I, Tables III, IV and V[2].

[1]As measured by the figures of employment in cotton weaving given in the *Ministry of Labour Gazette*. In 1950 the Census coverage was only 38 per cent. See Appendix III.

[2]Average earnings calculated from the Censuses for cotton weaving, are between eight and nine per cent. higher than those in the Ministry of Labour's earnings enquiries, in both October, 1946 and October, 1951.

EARNINGS IN COTTON WEAVING
OCTOBER 1946 = 100

	1948 April	1949 April	1951 April	1951 October
Total	120	127	148	157
Men	116	123	136	152
Women	120	127	146	155
Boys	133	136	160	171
Girls'	132	138	158	167

IV.

The Divergence between Rates and Earnings.

A comparison of the figures of rates and earnings shows a marked divergence both in spinning and weaving. In spinning, rates increased by 39 per cent. and earnings by 52 per cent. over the period; in weaving, rates increased by 33 per cent. and earnings by 57 per cent.; in the industry as a whole rates increased by 36 per cent. and earnings by 54 per cent. There is some evidence of a gradually widening margin between rates and earnings throughout the period, but earnings figures are not available regularly enough to measure changes in the margin accurately and precisely.

It is interesting to compare these figures for the cotton industry with those for industry generally. Over approximately the same period, wage rates in those industries covered by the Ministry of Labour's half-yearly enquiries increased by 24 per cent., while average actual earnings increased by 39 per cent.—a margin not very different from that for the cotton industry. There is thus no evidence that the forces which caused earnings to increase more rapidly than rates were significantly more powerful in cotton, than in industry generally.

Does the information we have collected enable us to explain the divergence between rates and earnings in the cotton industry? A comparison of the Ministry of Labour earnings figures and the index numbers of wage rates throws light on two of those factors which we suggested at the beginning of the article might account for the divergence; namely, changes in the distribution of labour by age and sex, and changes in the number of hours worked per week. In spinning, this is as

far as we can go, but in weaving, we can take the analysis much further, on the basis of the Wage Censuses. We shall therefore deal with these two factors for both sections of the industry first, and then proceed to the more detailed analysis for cotton weaving.

A comparison of the Ministry of Labour earnings figures with our wage rate index for spinning, shows a substantial divergence in the movement of rates and earnings for men, women, boys and girls. It was smaller for men and very striking for juveniles. Although there are big differences in the actual earnings of those four categories[1], changes in the distribution of the labour force between them made only a very slight contribution to the divergence for cotton spinning as a whole. There was a fall in the proportion of males employed, but an increase in the proportion of adults[2], and the net effect of this re-distribution only increased average earnings by one per cent.[3].

The changed distribution by age and sex in weaving was a little more important. Here, both males and adults increased as a percentage of the labour force[4], and the re-distribution therefore affected the average level of earnings more than in spinning[5]. The actual level of earnings in October, 1951, in

[1]In October, 1946, the average weekly earnings of men in cotton spinning were 113s. 5d., of women 66s. 4d., of boys 60s. 4d., of girls 49s. 11d.; in October, 1951, the average weekly earnings of men were 168s. 8d., of women 102s. 3d., of boys 93s. 10d., of girls 81s. (See Ministry of Labour earnings enquiries.)

[2]Males fell from 37 per cent. of the total in October, 1946, to 35 per cent. in October, 1951, and adults rose from 86 per cent. to 91 per cent. over the same period. (See monthly figures of employment in Ministry of Labour Gazette, and the six-monthly earnings enquiries.)

[3]That is, the increase in average earnings taking an unchanged labour distribution between these four categories throughout, is only one per cent. less than the actual increase in average earnings.

[4]Males rose from 32 per cent. of the total in October, 1946, to 35 per cent. in October, 1951; adults from 88 per cent. to 92 per cent. over the same period.

[5]In October, 1946, the average weekly earnings of men in cotton weaving were 108s., of women 70s. 10d., of boys 49s. 2d., and of girls 46s. 9d.; in October, 1951, the average weekly earnings of men were 163s. 10d., of women 109s. 6d., of boys 83s. 11d., and of girls 78s. 3d. (See Ministry of Labour earnings enquiries.)

weaving was 57 per cent. higher than in 1946 ; if the same distribution of labour between men, women, boys and girls had been employed as in 1946, the increase would have been 55 per cent.

The Ministry of Labour earnings enquiries show that the average number of hours worked per week in spinning, fell from 46.7 in October, 1946 to 44.4 in October, 1951, and that in weaving they fell from 45.6 to 44.9 per cent.[1]. This fall is, however, largely a reflection of the shortening of the standard week from 48 to 45 hours in December, 1946, and it is significant that the average number of hours worked was nearer to the standard week in 1951 than in 1946. It is difficult to discover whether this was due to a reduction in short-time working, an increase in overtime working, or to a falling off in absenteeism. But overtime work is not customary in the industry[2], and we know from the Ministry of Labour figures that there was practically no overtime working in 1951[3]. It would seem, therefore, that while earnings in 1951 were in no way inflated by a change in overtime working, the reduction in the standard week in 1946 reduced either, or both, absenteeism and short-time working during the period, and the 1951 earnings were higher on this account in both sections of the industry.

As we have explained, we can take the analysis of the margin between rates and earnings much further in cotton weaving. The main basis for this analysis is a comparison

[1]The Wage Censuses give the hours worked only in the ancillary section in cotton weaving. These figures show that the average number of hours worked there, fell from 47.3 in October, 1946, to 45.5 in October, 1951. These figures agree with the trend shown in the Ministry of Labour's figures for cotton weaving.

[2]There is some evidence that, in response to the special request of the Ministry of Labour for increased production in the Autumn of 1947, hours were increased by agreement and overtime rates were fixed, but these were meant to meet a special temporary emergency and did not operate for long.

[3]These figures first refer to June, 1951, and do not show cotton spinning and weaving separately until March, 1952. They show that for the week ending 30th June, 1951, if the short-time worked in the cotton industry were spread between all the workers it would amount to only three minutes per week, and the overtime to about twelve minutes ; for the week ending 22nd September, 1951, the short-time would amount to two minutes, and the overtime to about ten minutes.

between the figures for rates[1] and earnings[2,3]. We want, first of all, to distinguish between a divergence between rates and earnings due to earnings increasing faster than rates for each occupation, and a divergence which is merely due to a re-distribution of the labour force towards the more highly paid occupations. The easiest way of seeing the effect of re-distribution is to make out new indices of average earnings, taking actual earnings for each date for each occupation, but combining them with an unchanged labour force. This will give figures for groups, and for weaving as a whole, of what the increase in earnings would have been, if the occupational distribution of the labour force had remained the same as in 1946. A comparison of these figures with the indices of actual earnings will show how far earnings have risen because of re-distribution, and therefore how far this accounts for the divergence between rates and earnings. The results of such a comparison are given in the following table :

	Average Actual Earnings October 1951. October 1946 = 100	Average Earnings October 1951 with 1946 labour distribution. October 1946 = 100
Total	154	151
Weavers	156	150
Ancillary workers	146	151
Time Rate	145	148
Piece Rate	155	151
Skilled	151	149
Semi-skilled	155	148
Unskilled	147	148

For the cotton weaving industry as a whole, re-distribution had only a small effect on the general level of earnings ; with a

[1]Appendix I, Table II.

[2]Appendix I, Table III.

[3]Rates are measured in relation to February, 1946, and earnings in relation to October, 1946. The Ministry of Labour earnings figures show that average earnings increased by about 6s. between January and October, 1946, but since the wage rate increase of February, 1946 accounted for about 5s. of this increase, it has been assumed that earnings remained unchanged between February and October, 1946. Tables II and III may, therefore, be compared directly with each other.

stable labour distribution between the ancillary occupations and the groups of weavers distinguished in the Censuses, earnings would have increased by 51 per cent. instead of the actual increase of 54 per cent. But there are substantial differences in the extent and effect of re-distribution in separate sections of the industry. There was an appreciable movement towards the higher earnings groups among the weavers, while on balance, the movement among ancillary workers actually exerted a downward pressure on average earnings for that group. Average earnings of ancillary workers as a whole were throughout considerably higher than for the weavers[1], and the changes in methods of production tended to increase the relative importance of ancillary workers. In 1946 ancillary workers accounted for only 31 per cent. of those covered by the Census, but in 1951 for 40 per cent. Thus the re-distribution of labour between weavers and ancillary workers tended to raise the level of earnings for cotton weaving as a whole.

We can also group the occupations into those which are time rate or piece rate, and those which are skilled, semi-skilled or unskilled.[2] The pattern which emerges if we do this is largely a reflection of the occupational re-distribution to which we have referred. Re-distribution affected earnings for piece rate workers differently from time rate workers, because the piece rate workers were mainly weavers[3] and the time rate workers were all in the ancillary section of the industry. The movements for the skilled, semi-skilled and unskilled groups were rather more complicated. The semi-skilled consisted predominantly of the weavers[4] and re-distribution had much the same effect there

[1]Their average earnings in 1946 were 98s. 8d., the weavers' 82s. ; in 1951 they were 144s. and 128s. respectively.

[2]The increased importance of the ancillary section compared with the weaving section over the period, is reflected in the increased importance of the time rate as compared with the piece rate group, and of the unskilled with the semi-skilled group. Time rate workers rose from 12 per cent. to 18 per cent. of all workers over the period ; the unskilled rose from 6 per cent to 10 per cent. and the semi-skilled fell from 84 per cent. to 80 per cent.

[3]Weavers were about 76 per cent. of piece rate workers in 1946, and about 73 per cent. in 1951.

[4]Weavers were about 86 per cent. of the semi-skilled group in 1946, and about 80 per cent. in 1951.

as it had for the weavers as a group ; the skilled and unskilled workers were all in the ancillary section, and it is interesting to see that in the skilled group there was some re-distribution to higher earnings sections, but in the unskilled group the effect of re-distribution, although small, was in the opposite direction.

Although re-distribution had only a slight effect in total on the general level of earnings, its exact nature and effect on the earnings of weavers and ancillary workers is none the less worth analysing in more detail for the light that it throws on re-organisation in the industry. Over the period there was a marked fall in the proportion of weavers working on systems of four looms or less, and an increase in those working more than four looms[1]. At the same time there was some transfer of workers to the Cotton Manufacturing Commission (C.M.C.) system, or to automatic looms—but these two latter groups together still accounted for less than 12 per cent. of the total weavers in October, 1951. Since average earnings on more than four looms, on the C.M.C. system, and on automatic looms, were substantially higher than those on four looms or less[2], this transfer served to raise the general level of weavers' earnings. It is worth noticing that the highest level of earnings in October, 1951, was obtained by weavers on more than six non-automatic looms ; they earned 161s. 10d., which was appreciably higher than those on the C.M.C. system (156s. 4d.), and even slightly higher than those on automatic looms (160s. 10d.).

The Censuses show average earnings for weavers not only in the main groups according to the system of payment, but also by ranges of earnings within each group. We can thus see the extent of the spread of earnings within each group and whether this narrowed or widened over the period[3]. The spread of earnings among operatives working up to four looms was very wide ; for operatives on five and six looms, although

[1] See Appendix I, Table IV.

[2] Average earnings on four looms or less were 78s. 10d. in 1946 and 114s. 9d. in 1951 ; average earnings on five and six looms, more than six looms and C.M.C. looms, were 97s. 2d. in 1946 and 143s. in 1951.

[3] See Appendix I, Table V.

substantial, it was much less and decreased considerably ; for weavers on more than six looms, on the C.M.C. system, and on automatic looms it was still less, and decreased remarkably in 1951. This pattern of the spread of earnings is very much what one would expect. The weavers working four looms or less were a heterogeneous group—beginners just learning, the more experienced but relatively slow and inefficient weavers, the weavers on high quality and experimental cloths—and one would therefore expect them to have a very wide spread. On the other hand, weavers on automatic looms tended to work on standard cloths, and the C.M.C system was designed to eliminate the irrational and traditional elements in the wage systems which gave rise to the most peculiar variations in earnings. It is not surprising therefore that the spread of earnings among this group of weavers was relatively narrow.

As we have seen, the re-distribution among ancillary workers in weaving tended to reduce the increase in average earnings for that group. But this was merely the net result of a complex set of changes, some tending to depress, and some to increase, the level of average earnings for the group as a whole. The most significant change was the increased relative importance of the unskilled workers, from about 19 per cent. of all ancillary workers in 1946 to 24 per cent. in 1951. Since unskilled workers' earnings were well below those of the skilled[1], this change did much to reduce average earnings for ancillary workers as a whole.

On the other hand, there were two changes among ancillary workers—the increase in weft winders and loom overlookers—which worked in the opposite direction. Re-organisation in weaving after the war resulted in a greater demand for re-wound weft, so increasing the importance of weft winders[2] who earned on average more, although not a great deal more, than twist

[1]The average earnings of the skilled workers in 1946 were 140s. 3d., of the semi-skilled 81s. 5d., and of the unskilled 81s. 1d. ; in 1951, they were 211s. 1d., 126s. 1d. and 120s. 6d. respectively.

[2]Weft winders increased from 8 per cent. of all ancillary workers in 1946 to 17 per cent. in 1951, and twist winders decreased from 14 per cent. to 9 per cent.

winders[1]. The proportion of loom overlookers—easily the highest earners in the ancillary section[2]—increased from 53 to 55 per cent. of the skilled group. But these two changes were not sufficiently important to offset the other depressing changes in the ancillary section, and the total effect of re-distribution there was to reduce earnings from what they would have been with a stable labour distribution.

Although this analysis of the labour force in weaving reveals some interesting features of the changing methods in cotton weaving in the post-war period, it is important to remember that the net effect of this re-distribution on the margin between the movement of wage rates and earnings was quite small. Thus, when we compare the wage rate index with average earnings with the 1946 labour distributions—as is done in the following table—the major part of the divergence still remains.

	Wage Rates in August 1951. October 1946 = 100	Average Earnings in October 1951 with 1946 labour distribution. October 1946 = 100
Total	133	151
Weavers	134	150
Ancillary Workers	132	151
Time Rate	136	148
Piece Rate	133	151
Skilled	125	149
Semi-skilled	135	148
Unskilled	140	148

A remarkable feature of this table is the uniformity of increases in average earnings for different groups within the weaving section. Practically the whole of the variation in the divergence in the movement of rates and earnings is accounted for by differences in wage rates, and very little by differences

[1]Average earnings of weft winders were 68s. 2d. in 1946 and 110s. 10d. in 1951 ; of twist winders 64s. and 100s. 10d.

[2]Loom overlookers average earnings were 151s. in 1946 and 231s. 7d. in 1951.

in earnings. Thus the margin is greater for skilled than semi-skilled, and greater for semi-skilled than for unskilled workers because the wage rates for the skilled increased by 25 per cent., for the semi-skilled by 35 per cent., and for the unskilled by 40 per cent. The increase in earnings for the three groups was practically the same, at 48 to 49 per cent.

A good deal of this may be accounted for by the necessary conventions that have to be adopted in compiling a wage rate index. Take for instance the case of the skilled workers; their earnings increase was much like that of the other groups of workers, but their wage rate increase was only 25 per cent. Their wage rate increase was low for a number of reasons. Firstly, the skilled workers received the same flat rate increases as the other groups of workers, but since their 1946 average earnings were well above those of the other groups, the flat rate increases obviously gave a lower percentage increase for them than for the other groups. Secondly, in our wage rate index we have taken into account only those additions to rates which were centrally agreed by collective bargaining, and we have not been able to include the effects of those additional percentage or flat rate increases which were agreed to for particular areas, or individual mills. Since there is strong reason to believe that these locally agreed increases were more important among the skilled group than elsewhere[1], the wage rate index is depressed more for this group than for the others. Thirdly, since in our wage rate index we have not been able to take into account those changes in systems of payment which were introduced to enable workers to earn more money (and thereby to persuade them to remain in a particular mill), and since these changes were again more important for the skilled group than for any other[2], the index for that group is depressed more than for the other groups.

[1]The skilled workers were those with the highest scarcity premium, and in order to prevent a bottleneck in production by the loss of, for example, a tape sizer or a drawer to another employer, the rates of these workers were frequently supplemented in this way.

[2]These changes involved perhaps moving from time rate to piece rate systems, or to systems where a bonus was incorporated into the rate. For example many of the loom overlookers—who formed over one-half of the skilled workers—transferred from the poundage system to the wage plus bonus scheme which generally yielded higher earnings than they had previously been getting.

It is unfortunate that these changes could not be allowed for in our wage rate index. But they could only be taken into account by basing the index on normal earnings, which would then make it impossible to distinguish between movements in rates and in earnings. We cannot decide how far each of these three factors depressed the wage rate index for the skilled workers. In so far as the index is low for the first of these reasons, it gives a true measure of the relative rates of increase of the skilled as compared with the other groups of workers ; in so far as it is low for the second and third reasons however, it measures only a part of the total effect of changes in wage rates ; to that extent it gives a deceptively low measure of these changes, and hence exaggerates the divergence between rates and earnings for the skilled workers.

Take again the difference in the divergences for piece rate and time rate workers. The earnings increase of the piece rate workers is higher than for time rate workers, and the divergence between their rates and earnings appears to be considerately higher. This suggests that piece rate workers in cotton weaving were increasing their output by various means, and that this contributed to the divergence between rates and earnings in the industry. But in fact the difference in the divergences of the two groups is almost entirely due to the method of calculations of their wage rate indices. As was explained at the beginning of this article, flat rate increases in wages were related to minimum rates in 1946 for time rate workers, and to normal earnings for piece rate workers. If, as is almost certain, normal earnings in 1946 were above the minimum, this would mean that the same flat rate increase would give a smaller percentage increase in our index for workers on piece rates compared with workers on time rates. This problem could be overcome by basing the figures on normal earnings in all cases,

but this would virtually mean abandoning wage rate indices and confirming attention to earnings figures only.[1, 2]

These peculiarities of our wage rate index, indeed of any wage rate index, show how dangerous it is to use wage rate indices as a measure of changes in labour incomes, for the conventions that have to be adopted in calculating wage rate changes, in themselves, tend to produce a divergence between rates and earnings which is to some extent unreal. There is evidence that this misleading character of wage rate indices over the last few years is not confined to the cotton industry ; studies of shipbuilding and engineering suggest the same conclusion.

It is not possible to measure the extent to which the conventions of the wage rate index were responsible for the divergence, because of the impossibility of distinguishing clearly between a change in wage rates and in earnings, when systems of payment are changing, and when locally agreed additions to rates are important. But in so far as the wage rate index measured only changes in the legal wage rates, and did not include those additional changes which were regarded by operatives and employers alike as being properly part of wage rates, it gives a deceptively low picture of the increase in wage rates.

But even if the special qualifications relating to the conventions of the wage rate index could be taken into account, some margin between the wage rate index and the earnings index would still remain. What is important is, that over the period there were general factors operating throughout the cotton weaving industry, and for nearly all occupations which, in one way or another, enabled workers to earn more, in

[1]If the index for time rate workers had been based (like the piece rate workers') on 1946 average earnings, instead of on 1946 mimimum rates, it would have been reduced from 36 per cent. to 29 per cent. This would remove almost entirely the difference in the divergence between rates and earnings for the two groups.

[2]This accounts for part of the difference in rates for skilled, semi-skilled and unskilled, for about 80 per cent. of the skilled workers, and about 95 per cent. of the semi-skilled workers were on piece rates, and all the unskilled workers were on time rates. It also accounts for part of the divergence between rates and earnings for the weavers and, the ancillary section, as all the weavers, and between 55 and 60 per cent. of the ancillary workers, were on piece rates.

addition to the centrally agreed percentage and flat rate increases in wage rates which alone the wage rate index measures. A general willingness in times of good trade and shortage of labour, to pay special bonuses and to make payments above those agreed by collective bargaining, coupled with the re-deployment campaign, is probably the explanation and it is difficult to think of any others which would explain so general a movement. But since there is no concrete evidence to substantiate this view, it must remain largely guesswork.

V.

Conclusions.

How far has it been possible to explain the divergence between rates and earnings in cotton weaving ? Of the factors singled out for examination at the beginning of this article we have seen that re-distribution of the labour force, while producing many interesting changes, accounted for only a small part—about one-seventh—of the divergence between rates and earnings.

We have found some evidence to support the view that the earnings of piece rate workers increased more rapidly than those of time rate workers, but what is more significant in this context is, that the real divergence between rates and earnings increases was much the same for the two groups of workers.

We have seen that overtime working was of no real significance in cotton weaving during these years, but that the introduction of the shorter standard week reduced the amount of short-time working and of absenteeism, and thus contributed to the divergence between rates and earnings.

We have found that where the divergence was highest this was to a considerable extent a reflection of the conventions which had to be adopted in calculating the wage rate index.

We have not been able to measure the extent of the remaining divergence, but it probably consisted of those additional payments or bonuses, which were made to encourage workers to stay in the industry.

Finally, this attempt to compare wage rates and earnings in cotton weaving has shown clearly what an unsatisfactory and ambiguous concept a wage rate index is, when local wage rate agreements are common, and when systems of payment are changing. In such circumstances, it becomes impossible any longer to distinguish unambiguously between rates and earnings, and the wage rate index by confining itself to legal changes in rates for a particular job or grade has little practical significance.

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APPENDIX I.—TABLES.

TABLE I.

INDEX OF WEEKLY WAGE RATES OF WORKERS IN COTTON SPINNING FROM 1946 TO 1951.—October, 1946=100

	January 1948	May 1949	January 1951	August 1951
Cotton Rooms				
Head cotton room men	127	136	149	157
Assistant cotton room men ...	122	133	146	153
Cotton feeders	110	122	134	140
Total—Cotton Rooms...	118	129	141	149
Blowing Rooms				
Labourers	108	117	129	135
Men in charge of machines... ...	99	105	114	120
Apprentices and trainees	151	158	174	182
Total—Blowing Rooms	111	118	130	137
Card Rooms				
Strippers and grinders	131	137	151	159
Apprentice strippers & grinders	134	141	155	164
Lap carriers	111	120	132	139
Lap tenters	146	155	167	208
Comber tenters	114	120	132	138
Draw frame tenters	126	132	145	153
Card and can tenters	136	144	159	166
Slubbing tenters...	140	144	158	166
Intermediate tenters	115	121	133	140
Roving and jack tenters	108	114	125	131
Back tenters	112	117	129	135
Total—Card Rooms	120	127	140	147
Ring Rooms				
Sweepers, ticket markers, etc. ...	103	108	119	125
Oilers and banders	111	120	132	139
Ring doffers and gaiters	110	119	131	138
Ring jobbers	126	132	145	152
Ring spinners	113	118	130	136
Other card and ring room labour	111	120	132	139
Total—Ring Rooms	112	119	131	138
Mule Rooms				
Mule spinners	108	112	123	129
Spinner-piecers	109	115	127	133
Joiner spinners	110	117	128	135
Mule assistants	110	115	126	133
Ancillary staff	110	116	127	134
Mule cleaners	113	122	134	141
Tubers and creelers	151	159	175	183
Assistant spinners	115	127	139	146
Total—Mule Rooms	112	116	127	137
Winding Warehouse, etc.				
All workers	110	116	127	134
Overlookers	110	116	127	133
Total—Cotton Spinning	114	120	132	139

TABLE II.

INDEX OF WEEKLY WAGE RATES OF WORKERS IN COTTON WEAVING FROM 1946 TO 1951.

February, 1946=100.

	February 1948	March 1949	January 1951	August 1951
Weavers				
Under four looms	110	116	128	134
Four looms	109	115	127	133
Four looms and under	110	115	127	131
More than four looms...	105	112	125	137
Automatic looms	108	112	124	130
Juveniles	120	127	139	146
Total —Weavers	109	115	127	135
Ancillary Workers				
Winders	111	118	130	137
Warpers : male and female ...	110	115	127	133
Loom overlookers	105	108	119	125
Tape Sizers	106	109	120	126
Hand twisters and drawers ...	106	110	121	127
Warp tying machines : front and back men	106	109	120	126
Warp drawing machines :				
Men in charge	106	109	120	126
operators	107	111	122	128
springers	114	123	135	142
Clothlookers (21 and over) ...	112	117	129	135
Youths and boys in warehouse ...	109	114	125	132
Warehousemen, etc.	116	122	134	141
Weftmen and tape labourers ...	115	121	133	140
Chain beamers : male & female	108	112	124	130
Warp dressers	107	112	124	128
Dry tapers	106	111	122	127
Total—Ancillary Workers... ...	109	114	125	132
Total—Cotton Weaving	109	115	126	134

TABLE III.

INDEX OF AVERAGE WEEKLY EARNINGS OF WORKERS IN COTTON WEAVING FROM 1946 TO 1951.

October, 1946=100.

	October 1947	October 1948	October 1950	October 1951
Weavers				
Under four looms	107	118	132	152
Four looms	104	116	145	144
Four looms and under	104	116	143	146
More than four looms	105	116	127	147
Automatic looms[1]	100	112	131	156
Juveniles	102	121	134	153
Total—Weavers	105	118	140	156
Ancillary Workers				
Winders : twist	106	119	134	157
weft	105	121	137	163
grey	103	120	138	163
coloured	113	114	130	154
Total winders	106	120	137	163
Warpers : male	105	115	128	153
female	107	121	132	156
Loom overlookers	104	115	128	153
Tape sizers	102	110	121	143
Hand twisters	107	116	128	147
Hand drawers	103	113	119	141
Warp tying machines :				
front men	102	120	128	150
back men	105	130	138	165
Warp drawing machines :				
men in charge	103	121	126	152
operators	106	121	144	159
springers...	100	111	137	154
Clothlookers...	104	113	122	147
Clothtrimmers, etc.	103	116	123	142
Warehousemen, etc.	105	116	125	148
Weftmen & tape labourers ...	106	117	127	150
Chain beamers : male	108	121	134	157
female	107	117	127	152
Warp dressers	101	108	115	136
Dry tapers	106	119	132	161
Total—Ancillary Workers... ...	102	113	135	154
Total—Cotton Weaving	105	116	135	154

[1]Since weavers on automatic looms were not shown separately in the 1946 Census, this index has been based on 1947.

TABLE IV.

NUMBERS OF WORKERS COVERED BY THE WAGE CENSUSES BETWEEN 1946 AND 1951.

	1946	1947	1948	1950	1951
Weavers					
Under four looms ...	4,317	4,163	4,194	2,727	2,702
Four looms	19,687	19,736	18,203	14,421	15,792
Four looms and under ...	24,004	23,899	22,397	17,148	18,494
Five and six looms ...	8,115	10,027	8,809	9,737	12,204
More than six looms ...			2,577	2,457	2,941
C.M.C. looms				1,187	2,469
Automatics		921	924	1,627	2,254
Juveniles	2,501	2,790	2,406	2,374	2,724
Total—Weavers	34,620	37,637	37,113	34,530	41,086
Ancillary Workers					
Winders :					
twist	2,119	2,371	2,186	1,998	2,447
weft	1,273	2,030	1,805	2,971	4,503
other grey	298	549	305	900	442
other coloured ...	316	332	287	418	264
Total Winders	4,006	5,282	4,683	6,287	7,656
Beam warpers : male ...	103	136	124	118	126
female...	651	797	812	684	1,041
Loom overlookers ...	2,731	2,987	3,069	3,291	4,011
Tape sizers	567	652	648	639	809
Hand twisters	456	472	454	462	474
Warp tying machine :					
front men	178	192	238	296	395
back men	132	144	173	240	307
Hand drawers	933	1,058	1,082	995	1,194
Warp drawing machine men :					
men in charge ...	51	48	45	66	79
operators	50	55	46	71	83
springers	40	57	52	64	82
Clothlookers	1,283	1,360	1,419	1,559	2,102
Cloth trimmers, dressers, etc.... ...	433	645	659	930	1,013
Warehousemen, loom sweepers, etc. ...	2,570	3,733	4,094	4,330	5,494
Weftmen and tape labourers	960	1,180	1,202	1,365	1,633
Chain beamers: male ...	112	138	147	151	179
female ...	128	190	237	238	220
Warp dressers ...	220	220	130	135	147
Dry tapers	31	108	130	189	207
Total—Ancillary Workers ...	15,617	19,454	19,445	22,112	27,252
Total—Cotton Weaving	50,237	57,091	56,558	56,642	68,338

TABLE V.

THE DISPERSION IN EARNINGS AS A PERCENTAGE OF AVERAGE EARNINGS IN THE DIFFERENT SYSTEMS OF WEAVING BETWEEN 1946 AND 1951.[1]

	October 1946	October 1947	October 1948	October 1950	October 1951
	%	%	%	%	%
Less than four looms ...	20·6	23·8	22·1	19·9	19·1
Four looms	17·1	18·0	16·9	15·3	15·2
Juveniles	19·5	24·3	27·2	30·5	
More than four looms ...	14·2	16·6	13·8	12·4	9·8
Five and six looms ...			15·2	13·7	10·4
More than six looms ...			8·7	9·0	3·1
Automatic looms		18·6	16·2	11·4	6·0
C.M.C.				11·1	6·3

[1]The dispersion is measured by the standard deviation, which is the square root of the variance, or the mean of the square of each deviation from the average. In order to make comparisons between the different systems of weaving, the absolute figures of dispersion have been related to average earnings in each group, thus giving the dispersion as a percentage of average earnings, *i.e.*, the coefficient of variation.

APPENDIX II.

THE WAGE RATE INDEX.

The purpose of this note is to give some additional information on the coverage and construction of the wage rate index.

In cotton spinning the following occupations have been included in the index :—

Cotton Rooms Head cotton room men, assistant cotton room men, cotton feeders.

Blowing Rooms Labourers, men in charge of machines, apprentices and trainees.

Card Rooms Labourers, strippers and grinders and their apprentices, lap carriers, lap tenters, comber tenters, draw frame tenters, card and can tenters, slubbing tenters, intermediate tenters, roving and jack tenters, back tenters.

Ring Rooms Sweepers, ticket markers, etc., oilers and banders, ring doffers and gaiters, ring jobbers, ring spinners, other ring labourers.

Mule Rooms Mule spinners, spinner piecers, joiner spinners, mule assistants, cleaners, ancillary staff, tubers and creelers, assistant spinners.

Winding Warehouse, etc. Winders, reelers, beamers, crossballers, roller coverers, gassers, yarn warehousemen, doublers, cop packers, conditioners.

Overlookers

In cotton weaving the following occupations have been included in the index :—

Weavers

Ancillary Section Winders, warpers, loom overlookers, tape sizers, hand twisters, warp tying machine men, hand drawers, warp drawing machine men, clothlookers, cloth trimmers, warehousemen, weftmen and tape labourers, chain beamers, warp dressers, dry tapers.

Some explanation of the groupings adopted in the tables in the text is necessary. We have seen that there is no water-tight division into time rate and piece rate ; skilled, semi-skilled and unskilled ; male, female and juvenile. Consequently each occupation has been allocated to that group to which the majority of its workers belongs.

In cotton spinning occupations have been allocated as follows :—

Men All occupations in the cotton and blowing rooms, strippers and grinders and their apprentices, oilers and banders, jobbers and general labourers in the ring rooms, mule spinners, joiner spinners, assistant spinners, mule cleaners, roller coverers, yarn warehousemen and cop packers, and the overlookers.

Women All workers in the card rooms (except strippers and grinders and their apprentices, and back tenters), ring spinners, spinner piecers, winders and reelers, beamers and crossballers.

Boys Mule assistants, apprentice strippers and grinders.

Girls Ring doffers, gaiters, and back tenters.

During the re-organisation of the mule rooms, tubing and creeling became primarily an adult, where formerly it had been a juvenile occupation. While it is true that the increase in wage rates in tubing and creeling as an occupation was 83 per cent., it does not follow that this increase applied either to the men or boys occupied in tubing and creeling. Consequently the occupation has been excluded from both the " men " and " boys " categories. (It is worth noting that if the tubers and creelers were regarded as boys, the rate of increase for " boys " would have been as high as 67 per cent.)

Time Rate All workers in the cotton blowing and ring rooms (except the ring doffers and gaiters), strippers and grinders and juveniles in the card rooms, mule assistants ancillary workers, mule cleaners, assistant spinners, winders and reelers, beamers and crossballers, yarn warehousemen.

Piece Rate Ring doffers and gaiters, all workers in the card room (except strippers and grinders, their assistants, and juveniles), mule spinners, spinner piecers, joiner spinners, tubers and creelers, cop packers, doublers, gassers, roller coverers, and the overlookers.

Skilled Head cotton room men, men in charge of machines, apprentices and trainees in the blowing rooms, strippers and grinders and their assistants, ring jobbers, mule spinners, spinner piecers, joiner spinners, roller coverers, cop packers, and the overlookers.

Semi-skilled Tenters, ring spinners, assistant spinners, winders, reelers, beamers and crossballers.

Unskilled	Assistant cotton room men, cotton feeders, labourers in blowing rooms, lap carriers, sweepers, oilers and banders, ring doffers and gaiters, other card and ring room labour, mule assistants, mule cleaners, ancillary staff, tubers and creelers, yarn warehousemen, doublers and gassers.

In cotton weaving occupations have been allocated as follows :—

Men	Loom overlookers, hand twisters and drawers, dry tapers, warp dressers, weftmen and tape labourers, general warehousemen, clothlookers, tape sizers and workers on the warp tying and drawing machines.
Women	Weavers, warpers, winders, chain beamers.
Boys	Springers, youths and boys in the warehouse.
Girls	Juvenile weavers.
Time Rate	Tape sizers, workers on the warp tying and drawing machines, clothlookers, warehousemen, weftmen and tape labourers, youths and boys in warehouse, springers.
Piece Rate	Weavers, warpers, winders, loom overlookers, hand twisters and drawers, chain beamers, dry tapers, warp dressers.
Skilled	Loom overlookers, dry tapers, hand twisters and drawers, chain beamers, warp dressers, men in charge on warp drawing machines, front men on warp tying machines, tape sizers.
Semi-skilled	Weavers, winders, warpers, beamers, clothlookers, operators on warp drawing machines, back men on warp tying machines, weftmen and tape labourers.
Unskilled	Springers, general warehousemen, etc., cloth trimmers.

Since the wage rate increases granted to the majority of occupations in the cotton industry between 1946 and 1951 consisted of flat rate as well as percentage additions, they had to be related to an estimate of normal earnings in 1946. For workers on time rates this was taken to be the minimum time rate in 1946, and for workers on piece rates, estimates of average weekly earnings in 1946 were used.

The minimum time rates for 1946 were obtained from the 1946 issue of *Time Rates of Wages and Hours of Labour*, or from the *Ministry of Labour Gazette*. For piece rate workers in spinning, the table of average weekly earnings brought before the Evershed Commission at the end of October, 1945, was used to represent normal earnings in 1946. No change took place in wage rates between October, 1945, and October, 1946, for these workers in spinning whose post-1946 wage rate changes were related to this estimate of normal earnings, and it has been assumed that their earnings also remained unchanged between October, 1945 and October, 1946. (The spinner piecers were the one exception. They received a flat rate addition of 10s. in February, 1946, and it has been assumed that their normal earnings changed by an equal amount between October, 1945, and October, 1946.) For piece rate workers in weaving, the wage rate changes were related to the average weekly earnings calculated from the 1946 Wage Census of the Cotton Spinners' and Manufacturers' Association.

It is not possible to show how the intricate problems of translating the information about rates into percentage changes compared with 1946, were dealt with in every occupation, but examples of a time rate and a piece rate occupation, in both spinning and weaving are given to indicate how the indices were calculated. Ring jobbers and spinner piecers in spinning, youths and

boys in the warehouse and weavers on four looms in weaving, illustrate how the index was calculated for time rate, and for piece rate occupations in the two sections of the industry .

The ring jobbers' rate was increased by 22s. 2d. in January, 1948[1], by 5 per cent. in May, 1949[2], 10 per cent. in January, 1951[3], and 5 per cent. in August, 1951[4]. At the same time as this last increase of 5 per cent. was made, the employers decided to pay a bonus to all workers in cotton spinning and weaving in December, 1951, equivalent to 5 per cent. of earnings from January to August, 1951. This could be regarded as making the 5 per cent. increase in August retrospective to January, thus giving an increase of 15½ per cent. from that date and no increase in August ; or as a windfall payment, leaving the increases in rates at 10 per cent. in January and a further 5 per cent. in August. The latter alternative has been followed for all occupations in the cotton industry. The flat rate addition of 22s. 2d. in 1948 was related to the minimum time rate in 1946 for workers in this category of 87s. 10d.[5], giving an increase of 26 per cent. The later percentage increases were linked to this, giving the following figures for percentage changes since 1946 :

1946	January 1948	May 1949	January 1951	August 1951
100	126	132	145	152

[1]*Ministry of Labour Gazette*, February, 1948.
[2]*Ministry of Labour Gazette*, June, 1949.
[3]*Ministry of Labour Gazette*, February, 1951.
[4]*Ministry of Labour Gazette*, October, 1951.
[5]*Time Rates of Wages and Hours of Labour*, August, 1946.

The rate for spinner piecers was increased by 10s. in January, 1948[1], by 7s. 6d. in May, 1949[2], by 10 per cent. in January, 1951[3], and 5 per cent. in August, 1951[4]. In February, 1949, a new system of payment was introduced, linking the wages of spinner piecers to those of the mule spinners[5]. (Under the new system, spinner piecers were to receive 80 per cent. of the full productive rate of mule spinners, and since the rate for the average mule spinner was 150s., that for the spinner piecers was 120s.) Since spinner piecers were paid on a piece rate system, the flat rate increases had to be related to normal average earnings in 1946. The census of earnings in spinning taken for the Evershed Commission in 1945 showed earnings of spinner piecers to be 101s. a week in that year. Spinner piecers received a flat rate increase of 10s. a week in February, 1946[6], and for our index normal earnings in 1946 were assumed to be 111s. a week. Relating the flat rate and percentage increases to this basic figure for 1946, gave the following index over the period :—

1946	January 1948	May 1949	January 1951	August 1951
100	109	115	127	133

[1]*Ministry of Labour Gazette*, February, 1948.
[2]*Ministry of Labour Gazette*, June, 1949.
[3]*Ministry of Labour Gazette*, February, 1951.
[4]*Ministry of Labour Gazette*, October, 1951.
[5]*The "Evershed" List*, p. 25. The new system of February, 1949, gave a wage for the average spinner piecer of only 1s. different from the existing wage. Consequently the change is not mirrored in the index.
[6]*Ministry of Labour Gazette*, March, 1946.

Youths and boys in the warehouse received an increase of " 1s. 6d. or 1s. according to age " in October, 1947[7], " of proportional amounts rising from 3s. 9d. " a week in February, 1948[8], of 2s. 6d. a week in March, 1949[9], of 10 per cent. in January, 1951[3], and of 5 per cent. in August, 1951[4]. These youths and boys were paid on a scale with variations according to age, and the flat rate increases were related to this scale. Information about the range of this scale was available for May, 1951, only—47s. 10d. to 93s. 5d.[10].

[7] *Ministry of Labour Gazette*, November, 1947.
[8] *Ministry of Labour Gazette*, March, 1948.
[9] *Ministry of Labour Gazette*, April, 1949.
[3] *Ministry of Labour Gazette*, February, 1951 (*see footnote page 254*).
[4] *Ministry of Labour Gazette*, October, 1951 (*see footnote page 254*).
[10] *Cotton Spinners' and Manufacturers' Association Handbook*, p. 100.

Consequently the range of the scale had to be counted backwards. Having found the extent of the scale at the time of each change in the wage rate between October, 1946, and August, 1951, the mid-point of each scale was taken, and the index calculated with 1946 as base to give the following result :—

1946	October 1947	February 1948	March 1949	January 1951	August 1951
100	102	109	144	125	132

Weavers working on four looms received an increase of 7s. 6d. in February, 1948[1], of 4s. 6d. in March, 1949[2], of 10 per cent. in January, 1951[3], and of 5 per cent. in August, 1951[4]. Since weavers were paid on a piece rate system, the flat rate increase had to be related to normal earnings and these were taken from the Manufacturers Census to be 80s. in 1946. This gives the following index of wage rates for these weavers since 1946 :—

1946	February 1948	March 1949	January 1951	August 1951
100	109	115	127	133

Having calculated the index for each occupation, the index was calculated for cotton spinning and for cotton weaving by weighting each index with the earnings bill of its occupation. For cotton spinning, this was obtained from the table of average weekly earnings brought before the Evershed Commission in 1945 ; for cotton weaving, from the 1946 Wage Census of the Cotton Spinners' and Manufacturers' Association.

Finally, the index for the cotton industry was obtained by combining the indices for spinning and weaving, the estimated earnings bill of each section being used as weights. The earnings bill was estimated for spinning, from the average earnings figure calculated from the 1945 table of earnings (increased by 3 per cent. to allow for changes in earnings in spinning between October, 1945, and October, 1946), and the number employed in spinning in October, 1946. For weaving, the earnings bill was estimated from the average earnings figure derived from the 1946 Wage Census, and the number employed in weaving in October, 1946.

[1] *Ministry of Labour Gazette*, March, 1948.
[2] *Ministry of Labour Gazette*, April, 1949.
[3] *Ministry of Labour Gazette*, February, 1951.
[4] *Ministry of Labour Gazette*, October, 1951.

APPENDIX III.

THE COTTON SPINNERS' AND MANUFACTURERS' ASSOCIATION WAGE CENSUSES (MANUFACTURING SECTION), 1946 TO 1951.

The analysis of earnings in cotton weaving in this article has been based almost entirely on the Wage Censuses taken by the Cotton Spinners' and Manufacturers' Association during the years 1946 to 1951. The Wage Censuses are summaries of the results of the enquiries conducted in 1946, 1947, 1948, 1950 and 1951. We read in the 1948 census that "forms were sent to all manufacturing firms asking for an analysis of wages[1] paid during four consecutive weeks (45 hours) in October—November, 1948. These were to be gross wages, inclusive of flat rate payment and any payments under the Guaranteed Wage Agreement. Elderly and disabled weavers were to be excluded from the returns."

The following table compares the coverage of the Wage Censuses with that of the Ministry of Labour's six monthly enquiries.

COVERAGE OF WORKERS IN THE EARNINGS ENQUIRIES OF THE ASSOCIATION CENSUSES AND THE MINISTRY OF LABOUR.

	Employment in Cotton Weaving	Coverage of Wage Censuses	Percentage Coverage of Wage Censuses	Coverage of Ministry of Labour Enquiries	Percentage coverage of Ministry of Labour Enquiries
1946, Oct. ...	109,900	51,557	46	68,707	63
1947, Oct. ...	113,200	57,091	50	68,927	61
1948, Oct. ...	123,000	56,558	46	62,967	51
1950, Oct. ...	148,900	56,642	38	83,073	56
1951, Oct. ...	145,800	68,338	48	84,213	58

The information on earnings is set out in the Censuses in a number of ways. The information on weavers' earnings is given in two ways. Firstly the spread of earnings separately, for adult and for juvenile weavers. These tables show the percentage of the total number of weavers whose earnings fell within a certain range (each range amounting to 5s. or 10s.). Secondly, a "Comparative Analysis by Setts of Looms" divides the workers according to the system of weaving under which they were employed, and again gives the percentage of the total number whose earnings fell within certain earnings ranges (the ranges extend from "under 35s." to "over 145s." in the 1946, 1947 and 1948 Censuses; from "up to 60s." to "over 180s." in the 1950 Census, and from "up to 80s." to "over 200s." in the 1951 Census). For ancillary workers, the numbers employed, actual average earnings and hours worked are given for each occupation.

[1]To avoid confusion with wage rates the Census figures are referred to as earnings throughout this article.

This information has been used to calculate the increase in average earnings for the workers in cotton weaving. Some explanation of the methods used to calculate this increase is necessary.

In the weaving section indices have been calculated separately for weavers on four looms and under ; on more than four looms ; on automatic looms, and for the juvenile weavers. The rate of increase for weavers as a whole has also been calculated.

Earnings ranges were given in the Censuses for weavers on less than four looms, and for weavers on four looms. The rate of increase for weavers on four looms and under was calculated from the average earnings of these two groups.

Earnings ranges were given for weavers on more than four looms in 1946 and 1947, but for the later years this was divided into weavers on five and six looms, and on more than six looms. The average earnings for the two separate groups—five and six looms, and more than six looms—was calculated in the last three Censuses, and from these the average for weavers on more than four looms.

A complication arose over the inclusion of the C.M.C. weavers in the 1950 and 1951 Censuses. There is no way of telling on which system these weavers worked before they were transferred to the C.M.C. system, but the arbitrary method of including them with weavers on more than six looms has been adopted[1]. Thus the 1950 and 1951 average earnings figure for weavers on more than four looms represents the average earnings of weavers on five and six looms, on more than six looms, and on the C.M.C. looms.

The automatic looms were shown separately in the Wage Censuses for the first time in October, 1947. The earnings index of the weavers on these looms has therefore been calculated with 1947=100[2]. In order to include the earnings of weavers on automatic looms in the average for all weavers, and for all workers in cotton weaving, it has been assumed that the earnings of these weavers increased by the same proportion as the average for all other weavers between October, 1946, and October, 1947 (*i.e.*, by 6 per cent.), and that the number of weavers on these looms was the same in 1946 as in 1947.

In the ancillary section of the industry some categories of workers were included in the later years which were not included in the 1946 and 1947 Censuses. These groups, which consisted largely of juveniles have been excluded from all the calculations[3]. It has been seen that the proportion of juveniles to adults was declining during the period. The exclusion of these juveniles therefore meant exclusion of one of the factors causing average earnings for all workers to increase. This probably accounted in part for the lower rate of increase in earnings derived from the Censuses, than from the Ministry of Labour enquiries (54 per cent. and 57 per cent. respectively).

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[1]This increased the earnings of weavers on more than six looms from 133s. 6d. to 133s. 10d. in 1950, and reduced it from 161s. to 158s. 11d. in 1951. In 1950 C.M.C. weavers earned more than those on more than six looms, but in 1951 they earned less.

[2]See Appendix I, Table III.

[3]The increase in ancillary workers earnings (excluding the additional categories) was 46 per cent. ; including the additional categories it would have been 44 per cent.

The Underlying Issues of the 1949-50 Engineering Wage Claim[1]

I

The 1949-50 Engineering claim lasted for 17 months. It severely strained both the Confederation of Shipbuilding Unions and the negotiating machinery. It also opened the possibility of a national strike in engineering, at a time of serious economic difficulty, and this was only prevented by the vote of the rank and file.

The main thesis of this article is that the tortuous history of this claim was due to the delay in approaching the—still unsolved—problems of the wages structure, together with the use for political ends of dissatisfaction arising out of the delay over wages.

When the claim was raised there was a remarkable difference of opinion, both in the Amalgamated Engineering Union (A.E.U.) and in the Confederation, as to whether the long-term problems of the wages structure should be tackled, or shelved in favour of a straight claim. But this disagreement hardly accounts for the long-drawn-out nature of the claim, nor the raising of it after the return to a national policy of wage restraint, signalised by the issue of the White Paper on *Personal Incomes, Costs and Prices*[2] in February, 1948. Underlying this wage claim was a political conflict, for which the question of straight claim *v.* wages structure served as battleground. Its significance, therefore, transcends the issues of the engineering industry.

II

The A.E.U. is affiliated to the Confederation of Shipbuilding & Engineering Unions, which negotiates the wages for workers in the two industries. The relationship of the

[1]Thanks are due to the Amalgamated Engineering Union for their kind help; to the Confederation of Shipbuilding and Engineering Unions, both the Confederation itself and representatives of the T.G.W., N.U.G.M.W., and A.E.S.D.; and to the Engineering and Allied Employers' National Federation for access to figures of earnings. None of these is responsible for the views herein expressed.

[2]Cmd. 7326.

unions affiliated to the Confederation is described by Turner[1] in his account of the Crossley engineering strike. The Engineering & Allied Employers' National Federation is the negotiating body for the employers, of whom it includes the majority.

The wages of engineering craftsmen in other industries move with the rates in engineering proper, so that a wage claim here covers workers widespread in industry. Sharp[2] gives about 2,500,000 workers in engineering thus broadly defined. The wages of about 150,000 shipbuilding workers are closely linked with the engineering group. Thus a claim in engineering is likely to have repercussions throughout industry. Turner[3] has shown how it has operated as a lever in the post-war cycles of wage claims.

In June 1949 the National Committee, the representative body of the A.E.U., raised a claim for a wage rise of £1. Just before the Committee met, proposals for a revision of the wage structure had been presented to the employers for discussion, in accordance with the suggestion of the Court of Inquiry of 1948.[4]

There was a sharp division of opinion among the leadership of the A.E.U. ; the Executive Council, the officers of the union, opposed the claim, and urged instead the revision of the wages structure. The Committee accused the E.C. of trying to spike the claim by going ahead with these discussions, though the year before they had empowered the E.C. to do so. In his presidential address Mr. Tanner urged the Committee to have the moral courage to take unpopular decisions[5], but they voted unanimously for a straight wage rise.

Apparently the ordinary member of the A.E.U. also questioned the wisdom of the claim, for one hears of area and branch representatives discussing methods of securing support among the ranks.[6] Though the E.C. gave instructions

[1]H. A. Turner : " The Crossley Strike," *Manchester School*, 1950.
[2]I. Sharp : *Industrial Conciliation and Arbitration in Great Britain.*
[3]*Manchester Guardian*, Sept. 24th, 1952.
[4]Cmd. 7511.
[5]*Manchester Guardian*, June 21st, 1949.
[6]*The Engineer*, October, 1949.

that no influence was to be brought to bear upon members[1] considerable publicity was carried on, with the *Daily Worker* not behindhand.

The claim came before the Confederation of Shipbuilding and Engineering Unions in September and was agreed by 768,000 votes to 349,000[2]; two other skilled unions, the Electrical Trades Union (E.T.U.) and the National Union of Foundry Workers (N.U.F.W.) supporting the A.E.U. There was, however, strong opposition by the general workers' unions, the Transport & General Workers' Union and the National Union of General & Municipal Workers, the latter especially pressing for the new wages structure.

The claim was presented to the Engineering & Allied Employers' Federation on November 30th, and was rejected on February 1st, 1950. Whatever the hope of the E.C. of the A.E.U. that the wages structure might prove a solution to both long-term problems and current wage pressure, the employers refused to discuss the two issues together.

The National Committee of the A.E.U. met on March 2nd. In vain the E.C. suggested an official enquiry[3], though the proposal of the Communist faction to call a strike at once was also rejected. Instead the Committee demanded a ballot, on whether to strike or refer the claim to the National Arbitration Tribunal. In the Confederation there was sharp disagreement, and the A.E.U.'s proposal for a strike ballot was carried by only 624,000 to 519,000 votes[4]. The T. & G. W. and N.U.G.M.W. again opposed the A.E.U. and pressed for the wages structure to be reconsidered.

The conciliation machinery of the Ministry of Labour then came into play. The Chief Industrial Commissioner, Sir Robert Gould, met the Confederation on April 2nd, and urged them to postpone the ballot, but without avail. The upshot of the ballot, completed early in July, was a vindication of the moderates by 326,000 to 111,000, a vote of one-third of

[1] *The Times*, December 1st, 1949.

[2] *Manchester Guardian*, June 17th, 1950.

[3] *The Engineer*, April, 1950.

[4] *The Times*, March 10th, 1950.

the affiliated members. The general workers were strongly opposed, while even in the A.E.U. the voting was nearly 3 to 1.

Sir Robert Gould hastened to bring the parties together and formal negotiations began on September 20th. The employers put forward tentative proposals not for a general rise but simply for an increase on the minimum rates. They agreed that there was a case for a rise, owing to the increase in the cost of living, for the lowest paid workers, which meant the labourers and craftsmen on timework. Pieceworkers were not to be included.

The unions pointed out that the proposed minima would not benefit many timeworkers, since most were earning more than minimum wages. The employers maintained that the increase could not be higher, because of the effect on the related rates of semi-skilled workers throughout the industry. The precise point on which negotiations broke down was whether or not existing merit or other compensatory payments were to be taken into consideration when granting the proposed increase. The unions were ready to compromise on the increase being over and above these payments at least up to a certain ceiling, but this was unacceptable to the employers.

The general workers' unions in the Confederation wanted to accept the proposals but were defeated, and the issue was referred to arbitration. On November 13th the National Arbitration Tribunal sent a letter to the parties suggesting bases for agreement, and these were embodied in a settlement. A compromise was reached ; the labourer's rate was raised by 8/– to a floor of 100/–, up to a ceiling of 106/–, and the unskilled time-worker's rate was raised by 11/– to 118/–, up to a ceiling of 128/–.

The immediate upshot of these long negotiations was small, but the Ministry's figure for average earnings in engineering gives a considerable rise between October 1950 and April 1951 from 156/5 to 165/11, which suggests that a considerable number gained eventually. Dissatisfaction was expressed in a refusal to do piecework in some areas[1], and this brought local increases for a considerable number of workers.

[1] *Manchester Guardian*, February 20th, 1951.

III

Once negotiations began in earnest the complexity of the wages structure added to the difficulties of reaching a settlement. Indeed, any wage change in engineering has a widespread and often distorted effect, because the rates are connected, but not always logically.

The wages structure reflects conditions of demand and supply very inadequately, and this is mainly because of the way the earnings structure has been built up. It has grown haphazardly above the rate structure, and the old and new systems of craft and piecework payments are not properly related. This also gives rise to some dissatisfaction.

The wage rate is built on the old district " basic rates," reflecting pre-1914 local conditions. These differentials were frozen in the 1914-18 war, and since then rises have been largely in the form of flat-rate increases. The earnings structure has been built *ad hoc* over the years, with additional payments of various kinds for piece and timework.

The first anomaly is that earnings bear little relation to the rate structure. While the fitter's rate in January 1948 was 102/–, average earnings for timework were 140/8½d. There are also enormous variations in earnings between the different sections and areas of the industry[1]; taking the figures for men in 1948 they varied from 168/– for cars and cycles to 128/2 in agricultural machinery[2]. Average earnings varied from 122/– on the N.W. coast, with the Tyneside marine engineering, to 156/10¾ for the W. Midlands.[3]

These differences in earnings partly reflect the different conditions of the product market and labour supply. But this hardly accounts for the great variations in earnings of labour doing the same sort of work. Local and sectional differences would have more valid significance if there was an appropriate framework of national rates. This will become clearer as we examine the wage structure.

[1]K. Knowles: " Earnings in Engineering, 1926-48," *Oxford University Institute of Statistics Bulletin*, June 1951. For the whole of this paper I am indebted to Kenneth Knowles for his articles on engineering wages in the *Bulletin*.
[2]*Ministry of Labour Gazette*, April 1949.
[3]K. Knowles, *op. cit.*

WAGE RATES AND EARNINGS IN ENGINEERING IN SHILLINGS

MINIMUM WAGE RATES

		Jan. '48[1]	Oct. '48[2]	W.S.P.[3]	Nov. '50	Nov. '52
(P.)	F.	112·2	117·2	144	128·1	140
	L.	93	98		106·9	125·2
(T).	F.	102	107	120	118	136·3
	L.	87	92	96	100	117·3

(P. = piecework, T. = timework, F. = fitter, L. = labourer.)
1 and 2. This is the modal minimum, before consolidation.
3. Wages Structure Proposals.

AVERAGE EARNINGS

		Jan. 1948	June 1951
(P.)	F.	150·3	187·9
	L.	124·5	152·8
(T.)	F.	140·7	175·5
	L.	113·4	138·7
(P.)	S.	138·7	
(T.)	S.	115·3	

S. = semi-skilled.

The second anomaly is the lack of relation between the craft and piecework structures. The original framework was based on the traditional craft differential, the labourer receiving a certain percentage below the rate for the skilled man. Between 1914 and 1918 the margin of fitter's rate fell from 70% to 32% above the labourer's rate, by 1948 to only 16% ; though if we take earnings the real differential has fallen less, a fitter receiving 24% above a labourer in 1948.

The reasons for the narrowing of the craft differential have been examined by Knowles & Robertson[1] and by Turner[2] It may also be suggested that with the spread of education and more social equality, a narrowing of income differences is being accepted among the lower as among the higher income groups. There is no conclusive evidence about the effects of the decreased craft differential. Though there were 156,000

[1]K. Knowles & D. J. Robertson : " Differences between the wages of skilled and unskilled workers, 1880-1950," *O. U Institute of Statistics Bulletin*, April 1951.

[2]H. A. Turner : " Trade Unions, Differentials and the Levelling of Wages," *The Manchester School*, September 1952.

boys in Federated firms in 1938 and only 95,000 in 1952, the employers say there is no general shortage of apprentices.

While the percentage of skilled workers in Federated firms fell steadily from 60% in 1914 to 32% in 1933, the proportion of semi-skilled grew from 20% in 1914 to 57% in 1933.[1] For with the development of technique in the 1890s, large sections of the industry changed from small workshops of skilled men to production upon the assembly bench or conveyor belt, with a handful of highly-skilled toolroom and maintenance men. The older craftsman had an all-round skill while the new machinist, the semi-skilled, became expert on one machine only, and did not serve an apprenticeship.

The new methods tended to pull out of shape the original wages structure, as piecework was introduced. In the cross-section cited by Knowles[2] the proportion of pieceworkers in January, 1948, among craftsmen (fitters) was 61%, among semi-skilled 85% and among labourers 23%.

The pieceworker's rates were fixed to secure for a worker of average ability earnings above the timeworker by a margin equivalent to 27½%. [Increased to 45% by the 1950 settlement, to bring up the rate of the few actually on the minimum]. But the pieceworker's percentage is still calculated on the old district " base rates," *i.e.* on only a percentage of the present minimum timework wage. As a result the pieceworker's time differential (craftsmen) was in January 1948 only 9% above the timeworker ; reckoned by average earnings only 7%.

This might appear easy to remedy, by basing the piecework differential on the timeworker's full minimum rate. But in practice it is extremely difficult to arrive at a reasonable figure for the conversion. For piecework earnings vary enormously, and the upper ranges are sometimes very high. In the discussions of the early summer of 1949 the unions suggested a minimum piecework differential of 20% above the timework rate. But if the new rate were fixed so as to give the same minimum earnings as before, it would shift the whol

[1] M. L. Yates : *Wages and Conditions in British Engineering.*
[2] *Op. cit.* " Earnings in Engineering."

piecework earnings superstructure greatly upwards, since many pieceworkers are getting 60% or even 80%. If on the other hand the new minimum rate, on which the 20% would be calculated, were fixed so as to give the men now earning 50% the same earnings as before, the men now getting 27½% would lose.

The employers asked trenchantly if the higher paid men would stand for a reduction. This would be the workers' main contribution to a solution. It must, however, be remembered that the uncertainty of duration of piecework earnings in the past is felt as a reason why they should be relatively high. More extensive grading of minimum timework rates might help to remove this hangover of insecurity.

This brings us to the third problem, the absence of clearly defined rates for the semi-skilled. The conflicts of 1922 as of 1897 turned on the question of the employer's right to decide the rate for the new machines[1], and there are still no district, let alone national rates for the semi-skilled. Individual rates still vary from shop to shop according to relative bargaining strength between foremen and workers. The rates reflect historical differences and individual pressure, instead of being related to present productivity and negotiated by agreed channels.

The semi-skilled worker usually gets a percentage above the labourer's and below the craftsman's rate. It may be forgotten to which rate the semi-skilled rate is linked, and this is a source of irritation when a differential rise is accorded. Also the semi-skilled worker may earn more than the craftsman on timework. In June 1951 the average earnings of semi-skilled pieceworkers (taking turners and machinemen rated below fitters) were only 2/9 below those of fitters on timework, and their hourly earnings exceeded those of fitters.

The employers were in 1949 much less impressed than the unions with the need to regrade the semi-skilled on a national basis. They objected that regrading would mean the revision of innumerable piecework rates, which would be time-consuming and probably stir up unrest. On the other hand, against this

[1] J. B. Jeffreys, *The Story of the Engineers*.

must be weighed the long-term effect of not having clear grades.

In order to achieve a coherent wages structure it is necessary to have national grading for the semi-skilled; to consolidate firm minimum rates for piece as well as timeworkers, in order to relate the piece to the craft structure; and to build up a national earnings structure. Any attempt at change is difficult, since to alter one part changes the relations of all the rest. Also, the craft and piecework differentials are invested with the emotions attached to symbols of status, and of what is thought to be a fair return for skill or speed.

However, the A.E.U. proposals which were discussed with the employers in 1949, after being accepted by the Confederation, provided the outline of a coherent wages structure. Six grades were proposed, appropriate to the various degrees of skill. The old and new methods of payment were joined by stretching the craft differential to 25% above the labourer's rate; and this left a gap for the semi-skilled grades. Piecework payments were to be based on the consolidated time rates.

IV

Though the union accused the employers in the summer of 1949 of using the very considerable practical difficulties of revising the wages structure to stall, the raising of a straight wage claim by the union stymied the wages structure discussions. Looking further back, however, it was the failure of the earlier discussions on the wages structure to make more headway which gave extremists the opportunity to take the easy line of pressing a straight claim. This is the heart of the matter—unresolved problems leaving troubled waters in which to fish.

After the first post-war wage settlement of 1946 the A.E.U. and the Employers' Federation set up a joint committee to discuss the wages structure, revision of which had been raised by the National Committee of the A.E.U. in 1944. These talks broke down in December, 1947, without fruit. The decision of the engineers to press a claim in 1948, when there was a return to a firm national policy of wage restraint, must

be judged in the light of these unfulfilled hopes. This was recognised by the Court of Enquiry when they granted a rise of 5/–. The Court saw this increase as a prelude to dealing with the long-term problems of the wages structure, which they urged both sides to consider.

The engineers' expectation that the wages structure would be revised imposed a certain restraint on their claims in the immediate post-war years. During the war engineering real earnings rose more rapidly than men's earnings in general, but with the changeover to peace-time production they fell more rapidly, from 127 in 1944 (1939=100) to 110 by April, 1949. The fitter's rate rose between 1939 and 1949 by 58%, as compared with a general wage rate rise of 85%, and the real rate had fallen to 89 (1939=100) by April, 1949. During 1945–7 the fitter's rate was rising less steeply than the general wage rate. After the sharp rise in the cost of living in 1946–7 the increase of 1948 disappointed expectations, while the hopes of a solution to wages structure problems were still unrealised.

V

Nevertheless, the pressure of the National Committee for a straight wage claim in 1949 is not to be interpreted merely in terms of frustration over the wages structure accelerated by cost of living pressure. While this might explain the raising of the claim, it hardly accounts for the ignoring of the advice of the E.C., or for a pressure which nearly split the Confederation and nearly wrecked the negotiating machinery, and which, if successful, would have endangered the Government's economic policy. This is only adequately explained in the light of wider political issues. The Communists, like Saul, are zealots for their purposes, and so it was in this claim.

The possibility of an extremist minority carrying the day lies in the government of the A.E.U. The National Committee, the governing body, is composed of men working at the bench, elected annually by indirect election, and this helps a minority to rise to power. Further, with its directly elected lay officials and frequent referenda the A.E.U. claims a high degree of democracy, but wise leadership becomes more difficult.

Though the E.C. are almost always returned, the possibility of rejection makes them sensitive to the attitude of the ranks, whose opinions cannot easily be outdistanced by more foreseeing leadership.

The problem of leadership is accentuated by the separation of powers between the executive and legislative bodies. Policy is formulated by the annual meeting of the National Committee. The E.C. conclude rather than initiate discussion, partly because this is the union view of democracy, partly lest the Committee proceed like the traditional mule in the opposite direction.

The National Committee exercise power rather than responsibility. They do not have to negotiate, and they tend to speak with an eye to their constituency. Their speeches are spattered with slogans of earlier struggles, in contrast with the sober editorials of the union journal, *The Engineer*. There are, as it were, two sets of leaders, the irresponsible brother who expresses certain desires of the members, finding a scapegoat in the employers, and the elder brethren who have a firmer grasp of unpleasant realities. The rank and file may feel better when the National Committee let off steam, but they do not always follow them to the end.

Though the Communists are less than a quarter of the membership of the National Committee they often succeed in carrying their extreme demands, and in foisting impossible claims upon the E.C. The 1949–50 claim cannot be solely ascribed to Communist activity, since support for the claim was at first widespread. Nevertheless, the reckless way in which the claim was placed was due to a readiness to exploit the economic difficulties of the country, as the *Times*[1] said earlier. This was only finally repudiated by the vote of the rank and file on the strike ballot, which handed the claim back to the normal negotiating machinery.

When Russia entered the war, Communists had a chance to rise in the A.E.U., and with the end of the period of better relations between Russia and the West in 1947 they made an attempt to capture key positions. This was followed by a

[1] *The Times*, February 19th, 1948.

concerted attempt to oust them in 1950. One of the two Communist members of the E.C. was not re-elected, but Mr. Tanner himself was only returned as President on a second ballot. It was no accident that these politically contested elections succeeded the tortuous months of the '49–50 claim.

Once policy is agreed in the National Committee it is the task of the E.C. to implement it. In the Confederation the affiliated membership of the A.E.U. is so large that it is possible for this union together with only two other fair-sized unions to carry the day, and in 1949–50 the A.E.U. were supported by the E.T.U. and the N.U.F.W., the former with Communist leadership and the latter with considerable Communist influence.

VI

This claim was in effect an attempt to force a wage demand in a key industry. It must, however, be stressed that had there been greater readiness to tackle the long-term wage issues, there would have been less opportunity for making political capital out of these unsolved questions.

The problems of a complex and incoherent wages structure are admittedly formidable. Nevertheless, there was considerable goodwill. The E.C. of the A.E.U. and the general workers' unions in the Confederation both wanted a long-term solution. Had the ordinary members of the A.E.U. however, been better informed on the urgency and difficulty of the wages structure problems they might not have been carried away by a straight claim.

On the employers' side the widespread readiness to yield to wage pressure after the 1950 settlement suggests that there was considerable leeway for a solution. Just before the claim they showed themselves ready to discuss the wages structure. On the other hand, had there been more progress in the earlier discussion, there would have been less opportunity in 1949 for wage pressure.

It is not, therefore, that either side has refused to consider the wages structure. They have not, however, persevered to a solution, as the Court of Enquiry urged in 1948. The 1950

and 1952 claims again by-passed the industry's wage problems, which were nearer solution in the spring of 1949. Until both sides take up the threads from here, it is doubtful whether a constructive and lasting settlement will be achieved—and the troubled history of the 1949 claim shows one consequence of shelving difficult problems.

London. ANN TATLOW.

Employment for Women in the Development Areas 1939/51

One of the most significant features in the post-war economic history of the development areas has been the substantial increase in both the volume and range of employment opportunities made available to female workers.

In 1939 for every 100 men employed in Great Britain, there were some 38 women at work. In London and the South East, where many of the newer industries had established themselves and were developing fast, the figure was as high as 45 and in the North West region, the traditional home of the cotton textile trade, it was 52. On the other hand, in the South Wales development area only 15 women were employed for every 100 men and for the development areas as a whole, which at that time accounted for 20.5% of the country's total employed male labour force and 14.9% of the female labour force, the figure was 29.

Not only was the volume of female employment in the development areas much less than the average for the country as a whole,—the range of work available was also strictly limited in character. The economies of the development areas in 1939 (with the exception of the Scottish Development Area) were almost entirely given over to the three basic industries of coal mining, shipbuilding and heavy engineering—all trades in which the opportunities for female labour were particularly restricted. In fact employment for women workers at this time was largely concentrated in the service industries which between them accounted for 60—70% of the total female labour force (as compared with 44% for the country as a whole). Manufacturing industry accounted for 36% (as compared with 55% for the country as a whole) and of this amount the textile and clothing industries employed half. The balance of female employment—some 3.3%—was made up in agriculture, mining and building activities. Thus a very high proportion of the 663,800 women at work in the development areas in 1939 were directly dependent for their

livelihood on the prosperity of the basic industries : there was very little employment for women in industries the demand for whose products was not closely related to the economic prosperity of the basic industries. Even the main source of independent income, coming from the textile trade, was largely dependent on the vagaries of overseas demand for its main markets.

The war and post-war years have brought with them fundamental changes to the economic and social life of the development areas. Table I shows the relative movements that have taken place in the male and female labour force in each of the pre-war depressed regions, as compared with Great Britain as a whole.

TABLE I.

RELATIVE CHANGES IN NUMBERS EMPLOYED IN THE DEVELOPMENT AREAS AND GREAT BRITAIN
1939 = 100

Development Area	1945		1948		1951		% Change 1939-1951	
	M	F	M	F	M	F	M	F
North Eastern ...	82·1	166·5	99·5	138·5	99·3	149·7	—0·7	+49·7
South Wales ...	79·9	216·3	94·7	166·8	97·7	178·1	—2·3	+78·1
Scottish	77·3	118·5	96·9	106·8	95·2	113·8	—4·8	+13·8
West Cumberland	84·8	226·3	104·8	195·9	108·1	197·5	+8·1	+97·5
Wrexham	80·4	310·5	100·0	210·9	104·2	238·6	+4·2	+138·6
South Lancashire ...	69·9	126·1	87·3	113·4	91·8	120·9	—8·2	+20·9
Merseyside	73·7	112·6	94·7	107·4	98·8	112·5	—1·2	+12·5
All Development Areas	78·5	139·2	97·1	120·9	96·3	129·0	—3·7	+29·0
Great Britain ...	78·0	127·9	103·6	114·4	104·1	116·7	+4·1	+16·7

Notes on Table I.

All figures contained in the above and subsequent tables are derived from official Ministry of Labour Statistics and are based on the "new" coverage of insurance statistics. Figures for 1939 and 1945 have been adjusted accordingly.

Whilst there were less male workers in the development areas in 1951 than in 1939, anything which has been lost in this direction, has been more than made up by an increase in the female labour force of some 29%. The growth has been

particularly noticeable in those regions which previously employed the lowest proportion of female workers, *i.e.*, in South Wales, West Cumberland and Wrexham development areas. In Scotland, South Lancashire and Merseyside—those regions which in 1939 employed the largest proportion of female workers, the increase in employment has been below average. The main result has therefore been that the geographical distribution of female labour has been evened out to the extent that whilst in 1951, for every 100 men employed in Great Britain there were 52 women, the corresponding figure for the development areas was 45. The detailed figures are depicted in Table II.

TABLE II.

WOMEN PER 100 MEN EMPLOYED IN THE DEVELOPMENT AREAS AND GREAT BRITAIN
1939/51

Development Area	1939	1945	1951
North Eastern	21·3	43·2	38·3
South Wales	15·2	41·2	34·1
Scottish	41·9	61·5	54·2
West Cumberland	15·0	40·0	33·4
Wrexham	11·7	45·1	31·8
South Lancashire	32·6	58·7	46·2
Merseyside	45·1	67·7	56·7
All Development Areas	29·7	52·6	45·2
Great Britain	38·5	63·1	52·5

As a result of these movements the development areas decreased their share of the country's total male labour force to 18.6% in 1951, but increased their share of female workers to some 16.2%.

The industrial distribution of the female labour force has also undergone marked structural changes. Table III shows the main developments in this field and also the relative importance of women workers to each industry as shown by their percentage of the total insured labour force.

TABLE III.

INDUSTRIAL CLASSIFICATION OF FEMALE WORKERS IN THE DEVELOPMENT AREAS. 1939/1951 (excluding Merseyside)

Industry Group	Women Insured 1939	Women Insured 1951	Relative Change 1939=100	Women in % to all workers 1939	Women in % to all workers 1951
Agriculture, Forestry & Fishing ...	6,980	6,840	97·9	13·0	11·8
Mining & Quarrying	10,180	18,600	182·7	1·9	4·3
Chemical & Allied Trades ...	7,640	18,660	242·9	13·4	29·7
Metal Manufacture	5,890	14,770	250·8	3·7	8·4
Shipbuilding & Engineering ...	16,410	36,620	223·2	8·5	11·6
Electrical Products	1,050	19,620	1,868·6	23·4	56·8
Vehicles	2,530	10,260	405·5	8·2	14·4
Metal Goods not otherwise specified	8,500	17,790	209·3	22·8	33·4
Textiles	78,400	74,440	95·0	69·2	64·3
Clothing	39,880	68,550	171·9	76·3	81·8
Food, Drink & Tobacco	43,310	52,740	121·4	48·7	48·8
Other Manufacturing Industries ...	32,800	48,420	144·4	31·2	39·3
Building & Contracting	4.050	5,800	143·2	1·7	3·0
Public Utility Services (including Transport & Communication) ...	14,480	41,130	288·9	5·9	12·9
Distributive Trades	179,510	173,170	96·5	45·9	55·3
Professional Services (including Public Administration & Defence)	91,840	191,520	207·5	33·7	49·7
Miscellaneous Services	112,430	129,480	115·2	60·0	73·6
All Industries & Services	655,900	928,400	141·5	23·8	30·2

This table shows that only in agriculture, textiles and the distributive trades has there been an absolute decline in the number of women employed. In other fields of activity, particularly in all branches of manufacturing and in the professional services there have been large increases in the numbers at work. Much of the increase has taken place in those industries which employ a proportion of female workers, above the average, *e.g.* in the professional services and clothing and electrical goods industries, but there have also been considerable structural changes in the older industries, *e.g.* chemical, engineering and metal goods industries. This latter movement has enabled many women to make use of their experience first gained in the war-time dispersion and ordnance factories. However, whilst absolutely there were over 130,000 more women in manufacturing than in 1939, the relative

change in the industrial distribution has been less marked. As depicted in Table IV, the main loser over the years has been the distributive trades, the gain having been shared by the public administrative services, manufacturing, and public utilities.

TABLE IV.

PROPORTIONAL DISTRIBUTION OF INSURED WOMEN IN SEVEN BROAD INDUSTRIAL GROUPS IN THE DEVELOPMENT AREAS.

Industrial Group	1939	1948	1951
Agriculture, Fishing & Forestry ...	1·1	1·1	0·7
Mining & Quarrying	1·6	2·0	2·0
Manufacturing	36·0	35·6	39·0
Building & Contracting	0·6	0·7	0·6
Public Utilities (and Transport) ...	2·2	4·3	4·5
Distributive & Commercial Trades	27·4	18·7	18·6
Government & Other Professional Services	31·1	37·6	34·6
	100·0	100·0	100·0

Perhaps one of the most significant features has been the change in the relationship as between manufacturing industry and the distributive trades. Whilst in 1939 for every 100 women employed in manufacturing there were 76 in distribution, in 1951 the corresponding figure had declined to 48. Likewise there has been a growth in the relative importance of government and other professional services.

Also significant has been the change in the distribution of female workers *within* manufacturing. As a proportion of the total numbers employed in this field of activity the share of the textile industries has decreased from 34.4% to 20.3% whilst the engineering, electrical and vehicles groups have increased their contribution from 8.5% to 18.1%. The light electrical engineering industry first introduced into the development areas during the war years has brought with it great opportunities for women workers. Traditionally at home in the Midlands and the South many post-war branch plants of firms producing such products as radio and television sets, refrigerators, vacuum cleaners, office machinery, etc. have

established themselves in the development areas. Partly this has resulted from the Government's location of industry policy, partly it is because many such firms had already established war-time dispersion factories in these areas, and partly it is that acute labour and housing conditions have driven up costs in the South. For example, in the case of the electrical goods industry the total employment roll has risen from 4,050 to 34,530, and well over half of these are female workers.

The geographical distribution of the post-war developments has been fairly evenly spread between the main regions, though as one might expect from the nature of their economies, the Scottish and North Eastern development areas have accounted for the bulk of the new engineering and electrical industries, whilst in South Wales, the growth of clothing and chemical enterprises has been particularly marked.

Several indications of the benefits accruing from a substantial pool of unskilled female labour as well as some of the disadvantages of employing women and girls often completely inexperienced to factory life and discipline have been illustrated in three surveys carried out on the "Costs of Alternative Locations" as related to the boot and shoe, clothing and radio and television industries.[1]

Common to all these reports is the conclusion that the availability of large supplies of unskilled female labour has been the main attraction offered by the development areas in the post-war period, to newcomers opening up a factory in these areas.

To the economies of the development areas as a whole the added opportunities made available for female workers have injected a much needed element of stability. No longer are the economic fortunes of these areas dependent on two or three basic industries. Coal mining, for instance, has decreased its importance in relationship to other industries to the extent that whilst in 1939 it employed one-fifth of the total

[1]See for instance two studies published by the National Institute of Economic and Social Research in 1952: *The Cost of Industrial Movement*, by W. F. Luttrell, and *Costs of Alternative Locations*: *The Clothing Industry* by O. C. Hague and P. K. Newman.

labour force, it now employs less than one-ninth. Diversification of industry has been brought to these economies: the female labour force is producing goods and services which are sold in often totally different markets from those served by the products turned out by the male workers. What is more important is that, in the main, the growth in women's employment has mainly taken place in those industries which are in the stage of secular growth, *e.g.* motor car, electrical goods, office machinery, etc., and generally speaking serve diversified markets, often with products the demand for which is relatively inelastic.

Full employment in the basic industries has ensured that the development areas have prospered in recent years. Nevertheless the growth of the newer industries has added to this prosperity and it is in this way that the employment of women has made a major contribution. The economic unit of the family has been greatly stabilised by the growth of an independent source of income, now being earned by its female members. Whatever the social outcome of these post-war developments may be the economic advantages must surely far outweigh the disadvantages and this applies as much from the view-point of the country as a whole as from that of the development areas.

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